Professional Driving: An Emphasis on Organizational Safety Climate

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To my parents

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CONTENTS

ABSTRACT

According to the literature and statistical figures, professional drivers constitute a high-risk group in traffic and should be investigated in connection with the factors related to safe driving. However, safety-related behaviours and outcomes among professional drivers have attracted very little attention from safety researchers. In addition, comparing different professional and non-professional driver groups in terms of critical on-the-road characteristics and outcomes has been indicated in the literature as being necessary for a more comprehensive understanding of driver groups and the nature of driving itself. The aim of the present study was to investigate professional driving from a safety climate stand point in relation to predominant driving-related factors and by considering the differences between driver groups. Hence, four Sub-studies were conducted according to a framework emphasizing the relationships between safety climate, driver groups, driver stress, human factors (i.e., driver behaviour and performance) and accidents. Demographic information, as well as data for driver behaviour, performance, and driver stress was collected by questionnaire. The data was analysed using factor analysis, analysis of covariance as well as hierarchical and logistic regression analysis. The results revealed multi-dimensional factor structures for the safety climate measures. Considering the relationships between variables, differences were evidenced regarding on-the-road stress reactions, risky driver behaviours and penalties, between the various professional and non-professional driver groups. Driver stress was found to be related to accidents. The results also indicated that the safety climate has positive relationships with both driver behaviour and performance, and as well as involvement in accidents. The present study has a number of critical implications resulting from the fact that the way in which the effects of safety climate on professional driving were investigated, as well as the differences between professional and non-professional driver groups, was unique. Additionally, for the first time, a safety climate scale was developed specifically for professional drivers. According to the results of the study and to previous literature, a tentative model was proposed representing a possible route for the relationships between safety climate, human factors, driver stress, driver groups and accidents, by emphasizing the effects of safety climate.

LIST OF ORIGINAL PUBLICATIONS

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1. INTRODUCTION

1.1 General Introduction

More than 1.2 million people die each year on the roads, while between 20 and 50 million people suffering non-fatal injuries (World Health Organization [WHO], 2009). Road traffic accidents are on the way of being one of the first leading causes of death within the next 20 years. Although road transportation has benefits for the wellbeing of people, government, economic market, and health of the society in general by providing access; it might also have negative impacts, like the effects on individual lives and the economic cost, if the conditions it takes place are not safe enough. Professional drivers, i.e., people whose job is driving, constitute a high risk group in terms of road traffic accidents worldwide (see Baker et al., 1976). According to Charbotel et al. (2002), the main cause of occupational fatalities is road accidents in many countries. For example, about 25% of fatal work-related accidents in the USA (Toscano & Windau, 1994); approximately 25% of the fatal work accidents in Denmark, Finland and Sweden, and nearly 40% of fatal work accidents in France (Charbotel et al., 2002) are road accidents.

In the UK, traffic accidents were indicated to be the single largest cause of occupational fatality (Clarke et al., 2005); professional car drivers in the UK are about 50% more likely to be involved in an accident as compared to non-professional drivers even after demographic variables and exposure is controlled for their effects (Lynn & Lockwood, 1998). In Australia, professional drivers on average reported a higher level of crash involvement compared to non-professional car drivers (Downs et al., 1999; Lynn & Lockwood, 1998). In addition, the phenomenon of work-related road fatalities has become the most common form of work-related injury with approximately 40 work-related road fatalities in each month (see Haworth et al., 2000; Wheatley, 1997). In Turkey, more than 30% of fatal accidents (Trafik İstatistik Bülteni, 2009) are road accidents that professional drivers have been involved.

These figures and related literature show the importance of investigating professional drivers in terms of the characteristics, factors, and conditions having relationship with their task of driving. Additionally, as the previous literature emphasized (see Rosenbloom & Shahar, 2007) it is necessary to examine the professional driver groups in terms of the comparison of some characteristics in itself as well as with

non-professional driver groups for more comprehensive understanding of the nature of professional and non-professional driving and safety related outcomes.

1.2 Professional and non-professional driving

Professional drivers are at a high risk of being involved in road traffic accidents due to their high annual mileage (Baker et al., 1976; Dorn & Brown, 2003). In addition, as compared to non-professional driving, professional driving requires different demands from drivers. Driving task demands for professional drivers are, for instance, largely pre-determined. However, driving is a more self-paced task for non-professional drivers and they can largely determine the difficulty and risk level of their driving (Caird & Kline, 2004). Non-professional drivers can also choose the mode of transportation, time of travel, and target speed while driving. Driving is rather a less self-regulated task for professional drivers, because many different factors (e.g., time schedule, long working hours) increase their task demands. Professional driving has another distinct aspect: many organizational factors like a company's culture, safety policy and practices as well as safety climate might determine how safely a professional driver drives. Moreover, a professional driver working for an organization has usually very limited possibility to influence these organizational factors (Caird & Kline, 2004). All these issues might create differences in the level and sources of stress for professional and non-professional drivers (Dorn & Brown, 2003).

1.3 Accident: An outcome variable

Results of the variety of studies investigating accidents showed that accident is not a simple 'chance' related or 'cannot be anticipated' type of event (Shinar, 2007). In the study of accidents two approaches have extensively used: *clinical approach* and *epidemiological/statistical* approach. In the clinical approach, which is the theory based one, post-hoc detailed analyses of events, behaviours and conditions preceding the crash/accident are done to define the causal categories. At the most sophisticated level of this approach, experts from different disciplines (e.g., behavioural science, engineering) conduct an independent investigation of the relevant issues related to his/her area of expertise. Instead, statistical approach followed a theory-free point of view arguing that statistical probabilities should be used to discuss causation. To accomplish this, two data sets are used. The first one

is the file with accidents; while the second one is used to provide exposure data (i.e., not containing accident information in it). If a particular behaviour (e.g., speeding) is observed at a certain frequency in the accident file, then the frequency of the same behaviour (speeding) is obtained from the exposure file of the behaviour of all drivers who drive the same roads at the same times as the drivers with crash data. If the frequency of the behaviour is more common in the crash file it might be argued that this behaviour is associated with a high risk of crash involvement, but not necessarily causation is inferred from such a data (Shinar, 2007). This is a difference between two approaches. In the clinical based approach people feel comfortable while using the term 'cause', whereas in the statistical approach, the term 'risk' is preferred. Thus, a theoretical framework is needed to determine a causal relationship to explain some factors, for example, why increasing speed should cause more accidents.

According to the theoretical framework Turner (1978) focused on while exploring the accident occurrence, accidents are created through complex chains of events, with the accumulation of which, accident sequence is usually initiated long before the occurrence of the triggering event. According to Salmon et al. (2010) in the accident causation literature, human error models can be categorized as *person approach* (individual level errors are emphasized) or *system approach* (individual level errors are emphasized as being interacting with wider systematic errors/failures). Norman's schema activation error model (Norman, 1981), Reason's generic error modelling system (GEMS; Reason, 1990) and Rasmussen's (1982) model of human malfunction might be included in the person based models of human error. The research based on person approach typically attempts to identify the nature and frequency of the errors made by operators within complex systems with the ultimate aim of operator-focussed strategies and countermeasures designed to reduce variability in human behaviour. Criticism towards this approach is related to focusing the error countermeasures specifically upon human behaviour rather than the conditions of wider system (Reason, 2000). According to Salmon et al. (2010) person approach is dominant in some areas like healthcare, in practice. However, as a dominant influential and widely recognized approach of the present time in principle (Reason, 2008) the system approach to human error and accident causation also highly applicable in various contexts. Especially Reason's (1990) 'Swiss cheese'

model focusing on the latent conditions-unsafe acts interaction and their contribution to organizational accidents is now widely accepted and has been applied in most safety critical domains. The principles of the model are highly applicable in a road transport context as well. Nevertheless, some factors like the lack of appropriate methodologies, inadequate data collection systems, the resources required to undertake such applications, the open nature of the road transport system, and the placement of legal responsibility on individual drivers put back the system approach from implementations of its multi-dimensional applications within the road transport context (Salmon et al., 2010). Apart from the arguments on the theoretical point of view to accident occurrence there is a fact that accidents do not happen frequently as major injuries. For this reason, it may not be appropriate to use accidents as indices of unsafe behaviour, and the use of micro accidents that regarded as minor injuries requiring medical attention might be added in to the studies (Zohar, 2000). Nevertheless, regardless of the size of them, most road traffic accidents can directly be attributed to human factors as a sole or a contributory factor (Lewin, 1982).

1.4 Human factors in driving: Driver behaviours and performance

Human factors in driving can be investigated under two separate components: *driver behaviours/style* and *performance/skills*. Driver behaviour refers to the ways drivers choose to drive or habitually drive, including, for example, the choice of driving speed, habitual level of general attentiveness, and gap acceptance (Elander et al., 1993). In other words it explains what drivers usually ‘do’. Although they become established over a period of years, driver behaviours do not necessarily get safer with driving experience. Driver performance includes information processing and motor, and safety skills, which improve with practice and training, that is, with driving experience. It explains the best the driver ‘can’ do in a given situation (Elander et al., 1993).

1.4.1 Driver behaviours: Errors, violations and positive driver behaviours

Shinar (2007) claimed that a valid theory or model of behaviour is essential because it enables us to better understand on-the-road behaviours, predict driver’s reactions to potential safety measures, and develop new training programs, vehicle designs, highways, etc. The first models of behaviour (i.e., performance models emphasizing

the best a driver can do) were in cognitive psychology; the following model developers (i.e., motivational models emphasizing driver motivation) were from social psychology, personality and organizational behaviour (see Shinar, 2007 for a detailed explanation of theories and models of driver behaviour). Although several driving models have been developed to end up with a comprehensive one, the model developed by Reason et al. (1990) might be a turning point in the study of driver behaviours (Ranney, 1994).

According to Reason (1990), driver behaviours can be roughly divided into two categories; *errors* and *violations*. This differentiation provided base for the development of the Manchester Driver Behaviour Questionnaire (the DBQ; Reason et al., 1990). The DBQ showed that driver errors, violations, and slips and lapses are three empirically distinct classes of behaviour. Reason et al. (1990) defined errors as 'the failure of planned actions to achieve their intended consequences'; violations as 'deliberate deviations from those practices believed necessary to maintain the safe operation of a potentially hazardous system'; and slips and lapses as attention and memory failures. Unlike errors, violations were seen as deliberate behaviours, although both errors and violations are potentially dangerous and might lead to a crash. Parker et al. (1995a) indicated that slips and lapses might cause embarrassment but are unlikely to have an impact on driving safety.

Lawton et al. (1997) extended the DBQ by adding more items into the violations scale and split it into two distinctive scales, as ordinary violations and aggressive violations, according to the reason why drivers violate. Ordinary violations are deliberate deviations from safe driving without a specifically aggressive aim (e.g., speeding for saving time) whereas aggressive violations contain overtly aggressive acts (e.g., showing hostility by chasing other vehicles). Even though this addition of items have resulted in different factor solutions, the distinction between errors and violations, first shown by Reason et al. (1990), seem to be robust for private and professional drivers alike, both within and across different countries and cultures (Wallén Warner, 2006). The distinction between violations and errors is also supported by the findings showing that this two-factor solution was the most stable one (among possible solutions with two to six factors) over a three-year follow-up study in Finland (Özkan et al., 2006a). It should be noted that, concerning the

mentioned factor structure of the DBQ and in terms of traffic safety, speeding is a factor that should be taken into account specifically. It has direct and causal relationship with accident involvement (e.g., Aartsand & van Schagen, 2006; Carsten & Tate, 2005). Although in all countries there are rules for speeding while driving, and most drivers think that they are capable of choosing a safe speed; speed limits are widely violated (Elvik et al., 2004). In addition it has been shown as the most likely illegal behaviour to be reported by professional drivers (Davey et al., 2007). As compared to the other forms of violations like overtaking and close following; speed choice has been indicated as the most important driving style factor related to safety with a clear and consistent direction (see Elvik et al., 2004; Lajunen, 1997; Shinar, 2007; Summala, 1996). It has been shown that although there were cross-cultural differences in frequencies of errors and violations, speeding did not show any cross-cultural differences (Özkan et al., 2006a). Thus, in the present study, speeding has given particular attention and in addition to the speeding related violation items of the DBQ extra items were included within the study.

Both *violations* and *errors* were labelled as aberrant, and therefore negative, behaviours. Focusing on negative behaviours is well justified in terms of traffic safety. Everyday driving, on the other hand, involves other behaviours that cannot be described as negative (Özkan & Lajunen, 2005). These behaviours either have to be based on coded rules/regulations, or primarily take safety into account. The main intention in these behaviours is to take care of the traffic environment or other road users; to help and to be polite towards them with or without safety concerns. For example, drivers may care about the (traffic) environment (e.g., avoid causing air pollution or congestion) or other road users (Özkan & Lajunen, 2005). *Positive driver behaviours* include both passive (e.g., avoid causing delays or annoyance to other drivers) and active behaviours (e.g., moving to right side of the lane to ease overtaking, thanking by hand gesture). In order to extend the DBQ towards an omnibus measure of driver behaviour, Özkan and Lajunen (2005) added to the DBQ a scale for measuring positive driver behaviour and obtained a clear three-factor solution; *violations, errors,* and *positive behaviours*.

1.4.2 Driver performance: Perceptual-motor skills and safety skills

As a skilled activity, driving task has several hierarchically organized distinct levels (Summala, 1987; 1996). These levels might be ordered in the following way from bottom to top: *control* (operational), *manoeuvring* (guidance) and *planning* (navigational) levels (Johannsen & Rouse, 1979; Michon, 1985; Mikkonen & Keskinen, 1980; Summala, 1987, 1996; Van der Molen & Bötticher, 1988). In the beginning of driving these functions need conscious control. However, with more practice and driving experience they become automated (Summala, 1987). Development of different skills might show differences; while some skills develop within shorter periods of time (i.e., basic motor skills); development of some others (i.e., perceptual skills) takes more time.

Driver performance was differentiated as *technical* (i.e., quick and fluent car control, traffic situation management), and *defensive driving skills* (i.e., anticipatory accident avoidance skills) by Spolander (1983) who developed a self-report instrument to measure driving skills. Through this self-report instrument drivers were asked to take an external reference and compare themselves with 'an average driver' in thirteen aspects of driving. However, Spolander (1983) did not verify the empirical existence of these two factors in that questionnaire data through factor analysis. Those results addressed further clarification of the structure of self-assessed skill estimates based on the Spolander's (1983) scales. Later, Hatakka et al. (1992) changed this external reference into an internal one due to a well known finding that the majority of the drivers assess themselves as better than average drivers in their skills (Näätänen & Summala, 1976; Svenson, 1981). This time the drivers were asked to assess their own abilities in different aspects of driving skills. The two original factors (defensive and other skills) of Spolander (1983) and Hatakka et al. (1992) overlapped somewhat. Lajunen and Summala (1995) extended the contents of the Hatakka et al.'s (1992) scale to find a solution to the model. They argued that safety related motives should be included in the assessment of driving skills because a driver's view of himself/herself as a safe or dangerous driver may influence his/her driving style. As a result, they developed an instrument named the Driver Skill Inventory (DSI) to further assess both general perceptual-motor performance and safety concerns and verified the two-factor structure of the DSI as *perceptual-motor* and

safety skills. Lajunen and Summala (1995) suggested that the distinction between *perceptual-motor* (i.e., perception, decision making, motor control related skills) and *safety skills* (i.e., anticipatory accident avoidance skills) is a must because a driver's internal balance between these skills reflects her/his attitude to safety. A consistent factor structure and high reliability of the DSI was obtained for different populations and as a result of cross-cultural studies (Lajunen & Özkan, 2004; Lajunen & Summala, 1995; Lajunen et al., 1998a; 1998b; Özkan et al., 2006b).

1.5 Factors related to professional driving and safety

Concerning professional drivers, professional driving and safety, it is possible to talk about importance of variety of factors that might be investigated from an individual (e.g., personality characteristics of individual drivers); organization/company (e.g., structure, culture), group (e.g., bus, heavy vehicle drivers), nation (e.g., economy, infrastructure) or environment (e.g., climate) point of view. In the present study some predominant individual, organization and group related factors were focused on.

1.6 Individual related factors of professional driving and safety

In the driving literature, many studies have been conducted to investigate the relationships among individual related factors. For example, driver behaviours and performance of both professional and non-professional drivers have been studied in relation to age and sex (Elander et al., 1993; Laapotti, 2003; Lajunen & Parker, 2001); personality characteristic like sensation seeking, neuroticism, extroversion, type A personality (e.g., Brown, 1995; Dorn & Matthews, 1992; Horvath & Zuckerman, 1993; Matthews et al., 1991; West et al., 1992); attitudes and motives (e.g., Elander et al., 1993; Ulleberg & Rundmo, 2002); cognitive processes (e.g., Manstead et al., 1992; Ross, 1977); exposure (e.g., Brown, 1995; Corfitsen, 1993); fatigue (e.g., Morrow & Crum, 2004; Williamson et al., 1996), and sleep problems (e.g., Howard et al., 2004; McCartt et al., 2000). Although those and many other factors are rather related to driver behaviours and performance, and safety, the ones concerning the scope of the study have been mentioned about in the following sections.

1.6.1 Age and sex: Predominant demographic factors

Both age and sex were indicated as being directly related to driver behaviours, performance and accident involvement. For example, young men drivers were tend to commit violations more frequently as compared to the women and older drivers, while female and older drivers committed more errors as compared to young and man drivers (Blockey & Hartley, 1995; Parker et al., 2000; Reason et al, 1990). In terms of driver performance, male drivers were indicated to have higher perceptual-motor skills whereas female drivers scored higher on safety skills (Lajunen et al., 1998a; Lajunen & Summala, 1995). The majority of the people killed in traffic accidents are young men (Blockey & Hartley, 1995; Evans, 1991). Although age was indicated as related to accident liability among both young and older drivers, it might be argued that accidents at different ages might be results of different factors as well. For instance, as the driver gets older, deficiencies in visual acuity might be observed; while for younger drivers risky driving might be the cause of the accidents (Owsley et al., 1991; Summala, 1987). Increased risk of young male drivers is more related to attitudes and motivational factors rather than being related to age and sex (Lajunen, 1997). Thus, in spite of the results indicating the significant relationships among age, sex and hazardous driving, it is very difficult to clarify the relationship among those variables.

As a result of their studies conducted with professional and non-professional French drivers, Charbotel et al. (2010) showed that the people injured in work-related accidents were older than those injured during private trips. While the ages of the people in the former group changed from 25 to 34, the range changed from 18 to 24 for the people in the latter group. Regarding gender differences the results showed that, in the case of work related accidents, the distribution of age groups and the trends are similar for men and women. In another study conducted by Clarke et al. (2005), it was indicated that the crash-involved professional drivers were almost all male, and accident severity increased with age. Similarly men were found to have greater numbers of offenses than women (Bingham et al., 2006). Some of the previous studies provided evidence on the effects of sex and age on stress reactions of drivers as well. Male drivers reported comparatively higher aggression and comparatively lower overtaking tension compared to female drivers (Matthews et al.,

1999). Simon and Corbett (1996) reported a negative relationship between age and measure of general stress. Similarly, Gulian et al. (1989) found that older drivers reported less stress.

1.6.2 Driver Stress: A correlate of driving

As Gulian et al. (1990) indicated driving is a task where mild stress symptoms, like worry and unpleasant emotions, are observed frequently. In addition to the familiar daily experiences of life, severe life events, like divorce, might create stress in driving. At this point, as Mathews (1998) indicated, studying driver stress contributes to the understanding of the real world stressors' influence on cognition and performance; life stress; and road safety together with human factors related to road safety. For professional drivers, in addition to the general life stressors, job status and job demands have been emphasized as important stressors (see Matthews et al., 1999; Karasek &Theorell, 1990). This job related nature of professional driving highlights professional drivers as a specific and important group while studying driver stress. Thus, in the present study, driver stress was investigated as a predominant factor being related to professional driving and outcomes of it.

Mathews (1998) mentioned about some difficulties of constructing a model of driver stress and performance. Such that, objective measures of performance and a coherent theoretical framework is needed to distinguish symptoms from underlying causal processes; state expressions of stress from the trait expressions; and general stress related factors from driving specific factors. Some of the researchers investigating driver stress employed transactional models of stress (e.g., Gulian, et al., 1989; Matthews, 2001; 2002) emphasizing cognitions, and the ecological relationship between person and environment. As Matthews (2002) stated, a transactional model differentiates different classes of constructs interacting dynamically. These factors include personality factors, cognitive factors, environmental factors; and as outcomes, subjective stress symptoms and performance. The model suggests that environmental (e.g., high workload) and personality factors (e.g., dislike of driving) determine how external factors are interpreted, which in turn influences cognitive stress processes. Cognitive stress processes support two forms of outcome: subjective outcomes (e.g., anger) and performance outcomes (e.g., risk-taking). Feedbacks from outcomes to environment

go dynamically. Most of the time, the stressors are corrected over short period of time if the cognitive processing is not highly biased. Matthews (2002) emphasized that when cognitive processing is highly biased, stress outcomes might be more damaging for safety.

Gulian et al. (1989) and Glendon et al. (1993) developed the Driving Behaviour Inventory (DBI) by adopting a transactional approach where driver stress, and consequent driving performance are resulted from the interactive effects of "(i) the driver's assessment of the task environment (e.g. traffic density, weather); (ii) their assessment of their ability to cope with those conditions; and (iii) their selection of a behavioural strategy" (Westerman & Haigney, 2000, p. 3). In order to figure out the factors structure of the DBI, the data was collected from company car drivers on their emotional reactions to driving, and behaviour in demanding driving conditions. As a result, three principle dimensions of *aggression, dislike of driving* and *alertness*, and two minor dimensions related to overtaking: *irritation when overtaken* and *overtaking affect* were obtained. Studies showed that both *dislike of driving* – the dimension which is most strongly related to negative emotional reactions to driving – and *aggression* – the dimension which is related to feelings of post-drive anger – were related to some emotional and behavioural stress reactions (e.g., Matthews et al., 1991; Matthews & Wells, 1996). Later, some studies using the DBI revealed different factor solutions. Lajunen and Summala (1995) found only three factors, namely *aggression, dislike of driving* and *alertness*. The other two overtaking factors loaded predominantly on *aggression*. Westerman and Haigney (2000) suggested two new 'situation-specific' factors in a five-factor solution. These factors were named as *situation-specific tension* and *situation-specific concentration*. According to Glendon et al.'s (1993) studies, DBI scores were stable across a five-month period. Accordingly, the dimensions might be characterised as personality traits representing vulnerabilities to qualitatively different types of stress outcomes and linked to the driving context (Matthews et al., 1998).

Matthews et al. (1997) revised the previous factor structure of the DBI with the aims of adding assessment of fatigue reactions and enjoyment of driving to the principal dimensions of the DBI, and to apply transactional framework as the sampling basis while assessing drivers' stress vulnerability traits. The revised version of the DBI was

named as the Driver Stress Inventory which measured five dimensions of stress. In defining the Driver Stress Inventory scales, as different from the DBI scales, only appraisal and subjective stress symptom items were used. The name of the inventory has changed from 'behaviour' to 'stress' and it was indicated that coping and behavioural outcomes require separate assessment. The five scales of the Driver Stress Inventory were named as *dislike of driving*, *aggression*, *fatigue proneness*, *hazard monitoring*, and *thrill-seeking*. The first three dimensions of the Driver Stress Inventory predicted different types of subjective state disturbance during driving related to anxiety, anger and fatigue symptoms, respectively. *Hazard monitoring* dimension primarily reflects a coping style that aims to prevent threat by search for danger. *Thrill-seeking* is defined by items that describe enjoyment of danger (Matthews, 2002). Matthews et al. (1998) explained that, *aggression* and *dislike of driving* are related to broad cognitive-affective syndromes which are central to appraisal and coping styles. *Alertness/hazard monitoring, thrill-seeking* and *fatigue proneness* on the other hand, are somewhat narrower dimensions being related more clearly to coping than appraisal.

1.7 The relationships among driver behaviours and performance, stress reactions and accident involvement

Previous findings pointed that, violations predicted active loss-of-control and passive right-of-way accidents (Parker et al., 1995a; 1995b). Additionally violations were found to be related to speeding, and parking offences (Mesken et al., 2002). However, slips and lapses were not indicated as having impact on safety (Parker et al., 1995a) in spite of the association between high lapses scores and passive accident involvement (Parker et al., 2000). Errors and lapses, taken together, were found to be significant predictors of accidents as many times as the various violation factors (Dobson et al., 1999; Meadows et al., 1998; Özkan & Lajunen 2005; Özkan et al., 2006a; Parker et al., 1995a; 1995b; Sümer, 2003). The only study that did not find any effect was conducted by Blockey and Hartley (1995).

Literature on the relationship between accident involvement and driver performance indicated that there is an asymmetric relationship between perceptual-motor and safety skills. Overestimation of perceptual-motor skills may predispose drivers to risky driver behaviours. However, by means of safety skills they become more

cautious and able to anticipate possible hazards on the road (Sümer et al., 2006). The drivers reporting low level of safety skills but a high level of perceptual-motor skills had the highest levels of accidents and penalties. The relationship between perceptual-motor skills, accidents, and penalties were negative (Lajunen et al., 1998a). The balance between perceptual-motor skills and safety skills has been proposed as critical for driving safely (Lajunen et al., 1998b).

Driver stress and driving safety relationship has been investigated previously within variety of researches (e.g., Evans et al., 1987; Magnavita et al., 1997). Aggression, thrill-seeking and to some extent low hazard monitoring were found to predict self-reported accident involvement. Aggression, thrill-seeking, and low dislike of driving were reported to be related to offences such as speeding, and to higher self-reported violations. Higher rates of self-reported errors were associated with high aggression, thrill-seeking, dislike and fatigue proneness, and with low hazard monitoring (Dorn & Matthews, 1995). As a result of their study on the relationship among the DBI scales and the DBQ factors, Westerman and Haigney (2000) indicated that driver stress is related to both errors and violations and several facets of driver stress will have different impact on driver behaviours. The results of this study indicated that, high levels of driver stress were associated with increased self-report of the DBQ factors. According to Matthews et al. (1999), if the job involves vehicle driving, there is a possibility of work demands to influence the drivers' general attitudes and reactions toward driving. Similarly, Karasek and Theorell (1990) asserted that job status and work demands may influence stress outcomes interactively in such a way that people may perceive the high workloads as less aversive if they have some control over work activities. They also emphasized the role of driver stress as a factor increasing the likelihood of accident involvement and its cost for companies. Gulian et al. (1989) found correlations between dislike of driving and reports of work stressors, like worries about redundancy and retirement.

1.8 Organization related factors of professional driving and safety

Organizations are complex systems having values, principles, attitudes and viewpoints making them different from others (Arnold, 1998). The previous literature shows that behaviours and job performance might be influenced from different organization related factors (e.g., Antonsen, 2009; Guldenmund, 2010; Rundmo & Iversen, 2007). In addition to being complex, organizations are also dynamic and multi-faceted human systems operating in dynamic environments. Conditions or situations at one time and one place cannot be generalized into a constant truth (Dawson, 1996). Accordingly, it could be assumed that in an organization there might be different factors affecting some aspects of professional driving, which is a task on which the professional drivers are expected to show their performance within work related context, i.e., in traffic settings. These factors might be collected under three main categories as *structure* (i.e., the formal organization); *culture* (i.e., basic assumptions); and *the process* (i.e., the primary processes exist in the organization). The behaviour is determined as a result of the interaction of these factors (Guldenmund, 2010).

Although before 1980s more structural/technical aspects of the organizations were emphasized as being related to performance and safety issues; especially after big organizational accidents a shift from the technical aspects of work environments to human factor related aspects has been observed (Gravan & O'Brein, 2001). Occupational safety has gained significant importance and the tendency to seek the causes of accidents by considering the interaction between technology and organizational factors/failures has increased considerably (Pidgeon & O'Leary, 2000). After the nuclear accident at Chernobyl in 1986, accident investigations have started to be made by taking organizational culture as a base and poor safety culture was indicated as a contributory factor for the accident (see Pidgeon, 1998; Cox & Flin, 1998; Weick, 1987).

1.8.1 Organizational culture and climate

Hofstede (2001) indicated that if national culture defines the collective mental programming of the mind distinguishing the people of one nation from another; organizational culture might mean the collective mental programming of the mind

distinguishing the members of one organization from another. Moreover, Hofstede distinguished organizational cultures from national cultures and mentioned about these two concepts as complementary. He emphasized that as representing two different levels of aggregation, organizational cultures distinguish organizations while holding the national culture constant, whereas national cultures distinguish nations by holding organizational cultures constant, at least as much as possible. Antonsen (2009) indicated that anthropological definitions of culture might be applied to national culture not to the organizational culture as the primary socialization of organizational members does not take place within the borders of organization as a cultural unit. That is, the roots of organizational culture are not as deep as that of national culture. Although the concepts of organizational culture and climate has been studied so far since 1970s, it is very difficult to say that there has been a consensus on the definitions of and differences between these two concepts, as well as the models to develop to understand and explore their relationships with other variables (e.g., Glick, 1985; Guldenmund, 2000; Schein, 1992; James et al., 2008).

1.8.1.1 Definitions and characteristics of organizational culture and climate

As Guldenmund (2010) indicated, different definitions of organizational culture and climate have been proposed in the literature for the purpose of focusing the research. Example definitions of culture and climate are listed below:

Organizational Culture

- According to Schein (1992) organizational culture is “a pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think and feel in relation to those problems” (p. 12).

Organizational Climate

- Zohar (1980) defined organizational climate as “a summary of molar perceptions that employees share about their work environments” (p. 96). Those perceptions are thought to have a psychological utility in serving as a frame of reference for guiding appropriate and adaptive task behaviours.

As the definitions imply and the literature indicates, culture and climate concepts have some differences besides the similarities between them. Guldenmund (2000; 2010) investigated the characteristics of culture and climate concepts in detail and discussed the methodological differences between these two concepts. Accordingly it was indicated that culture research is based mainly on qualitative methods (e.g., field notes, quotes), whereas climate research is conducted mostly by using quantitative methods (e.g., questionnaires) that share a lot of similarities with attitude measurements. According to Denison (1996) culture research aims at achieving a deep understanding of the underlying mechanisms whereas climate research deals with organizational members' perception of organizational practices and how these practices and perceptions are categorized into the analytical dimensions defined by the researchers (see Guldenmund, 2000 for more detailed expression of the characteristics of culture and climate concepts). In culture research, understanding is important whereas in climate research emphasize is on change or improvement (Guldenmund, 2010). Hofstede (1998) indicated that climate is more related to individuals' motivation and behaviour, whereas culture is entirely placed at the organizational level. In a similar vein James et al. (2008) stated that organizational climate is a property of individual whereas culture is a property of organization. While culture research specifies the deep psychological attributes, like values, emphasizes the socialization process of culture and development and etiology of culture over time depending on this socialization process; climate research deals with more identifiable organizational features, like safety and service by using measurement and documentation advantage of it (Ashkanasy et al., 2000).

1.8.1.2 Conceptualization of organizational culture and climate

Operationalisation of culture and climate is pretty important because the relationship with other variables/concepts might differ depending on the way these concepts are operationally defined (Guldenmund, 2010). Culture and climate researches are not parallel to each other; the study of climate preceded that of culture (Ashkanasy et al., 2000). The roots of climate research go back to the Field Theory of Kurt Lewin and his colleagues. Lewin et al. (1939) mentioned about the concept of climate in social psychology to indicate the psychological conditions created by the leaders of boys' groups. This study of Lewin and his colleagues was grounded in Gestalt psychology

and aimed to investigate the interaction patterns between the individual in the field/environment. According to the critical notion of the whole of Gestalt psychology, individuals reform the individual elements of perception into wholes representing more than a simple sum of the individual pieces. Based on this logic, climate, or atmosphere, is constituted by the sense that people make of their patterns of experience and behaviours or other parties within the same situation. At a later time McGregor represented the concept of organizational climate with an emphasis to 'managerial climate' in 1960, when the assessment of organizational climate has started to be made via the development of questionnaires. However, the issue of aggregation has been a topic of discussion in the climate research as a result of analysis of individual level data at organizational level.

The term organizational climate was a broad construct studied by the researchers. However, it has successively been restricted to attitudinal or psychological phenomena within the organizational context. Jones and James (1979) underlined the tendency to stress the descriptive and cognitive nature of climate to divorce it from the affective and evaluative aspects of job-related attitudes. It might be possible to find conceptual distinctions between perceptual/cognitive representations of a situation and evaluative/affective reactions to that situation. Nevertheless, it should be considered that concept formation and attitude formation processes have parallels that might result in close and dynamic relationships to each other which are quite difficult to distinguish (James & Jones, 1974; Jones & James, 1979; Schneider, 1975).

As indicated by Ashkanasy et al. (2000) in the late 1970s the concept of organizational culture has emerged as an alternative way to make the same conceptualization of Gestalt of organizations for their members emerged. The concept of climate was replaced by culture. Since the emergence of it, the term of organizational culture dominated the research literature with the comprehensive meaning covered by the term climate in the beginning. However, domination of the concept of culture did not solve the problem of ambiguity; it was not free from problem. As Martin (1992) indicated the problem of culture might 'being almost anything and as a result being everything' depending on the researcher conducting the research.

The fact that the distinction between culture and climate concepts should be resolved has been taken the attention of plenty of researchers so far, however many authors fail to discriminate these two concepts. Some researchers preferred to use these two terms interchangeably (e.g., Parker, et al., 2006; Katz and Kahn, 1978); while others indicated that they are two separate concepts (Ott, 1989; Yule, 2003); while some others indicated that they are not (e.g., Ashkansy, et al., 2000; Antonsen, 2009; Denison, 1996). Some other researchers even did not prefer to mention about the concept of climate in their models/studies (e.g. Martin, 1992; Schein, 1992). As a result it seems that even the studies up to the recent times have difficulties in displaying precise borders on the definition and contents of these two concepts (see, Antonsen, 2009; Guldenmund, 2010). One reason for not ending up with clear definitions and conceptualizations of culture and climate concepts might be related to the studies conducted on organizational climate. That is, a decade ago it has been indicated that, there has been virtually no research to investigate the development of climate in organizations or to understand the nature of this concept, which should be the main focus (Ashkanasy et al., 2000).

Organizational culture is a concept having multiple levels (Schein, 1992; Hofstede, 1991). Hofstede (1998) suggested that in the way the cross-national studies determine national culture dimensions, the cross-organizational studies determine organizational culture dimensions. As a result of his study investigating 1295 individual employees' responses as aggregated into mean scores for twenty organizational units, it was indicated that organizational culture could be described with six dimensions: *process oriented versus results oriented, employee oriented versus job oriented, parochial versus professional*, *open versus closed*, *loose versus tight,* and *normative versus pragmatic* (see Hofstede, 1998).

Schein's (1992) classification of organizational culture includes three levels: *artefacts*, *espoused values* and *basic assumptions*. In order to understand the core of the culture the data collected from its periphery is used. The core is the nature of the culture and it is not possible to directly measure it. According to Schein (1992) it is the basic assumptions operating in an organization, the other two layers of artefacts and espoused values are the manifestations of culture. Artefacts are easy to read but not to understand in terms of culture. They alone do not provide any insight in to the

motivation or thought process underlying them. Their relation to the underlying culture is not easy to understand. They might be accepted as raw material to understand basic assumptions and culture as a whole and be combined with other artefacts and espoused values to that end. Behaviour might be a part of the core of the culture; it might be an expression of basic assumptions however might be an expression of some external conditions like weather, or internal conditions like psychological states. According to Schein (1992) organizational climate is nothing more than what he calls artefacts, or manifestations and reflections of cultural assumptions.

Ashkanasy et al. (2000) argued that culture and climate should not be investigated as two distinct concepts. Climate is individually perceived and experienced as different from culture; however culture cannot have effects without individuals seeing it. This 'link' between them shows that these two concepts are connected to each other although some researchers disregarded this connection. Both organizational climate and organizational culture are related to the creation and influence of social context in organizations (Denison, 1996). Thus, when one talks about climate change, it is not a process that is unrelated to culture. That is, if the desired climate is not congruent with the underlying assumptions, it is not possible to make the desired change. For example, if the underlying assumptions in an organization are 'individual and comparative', climate of 'teamwork and cooperation' cannot be created.

In his review paper Schneider (1975) indicated organizational climate as an amorphous and inclusive concept having amorphous measurements, as a result. As climate concept has many potential faces causing not to have a specific focus, climate research has to focus on *something*. In other words, *climate for something* should be emphasized in climate research. Concordantly, Zohar (1980) indicated that within a single organization different climates are created. In other words, the term organizational climate should be added an appropriate adjective indicating the type of the climate like 'motivation climate' (Litwin & Stringer, 1968); 'safety climate' (Zohar, 1980); and 'creativity climate' (Taylor, 1972) so that the term describes a specific area of research, as well as becoming more narrow and tangible (Guldenmund, 2000; James et al., 2008).

1.8.1.3 Safety culture and climate as aspects of organizational culture

The concept of safety

As an aspect of organizational culture, safety culture and climate might provide a transition from organizational culture to safety. Before mentioning about where safety culture and climate stands within the organization, it might be important to understand the concept of 'safety'. As Antonsen (2009) emphasized, safety has to do with minimizing the risk by reducing the occurrence probability of dangerous event; or by reducing the consequences of that event, if it happens. Danger is a true reality; risk, on the other hand, is the evaluations of dangers (Douglas, 1992). Definition of safety consists of three elements: a relation to a *state or situation*, where statistical risk can be mentioned about; *feeling of security* or *control*; and lastly includes *practice* (i.e., work performance or organizational, technological, physical barriers) by which the probability of dangerous event change (Antonsen, 2009).

In the process of studying safety within organizations, *engineering perspective* put emphasis on safety systems or management whereas the studies relied on the *psychological perspective* has stressed attitudes and behaviours in relation to safety (Pidgeon, 1998). According to Hale and Hoven (1998), organizational safety has developed through three 'ages of safety': *technical age* (e.g., safer machines and equipment), *human factor age* (e.g., strategic recruitment, upgrading employee's skills increasing employee motivation), and *management systems age* (e.g., organizational conditions for safety, management systems). In a recent research, Hudson (2007) mentioned about three waves: *technical wave, system wave* and *culture wave*. Both point of views indicated that these stages are sequential. Glendon et al. (2006) on the other hand, stressed that the period of development should be on the way that the latter builds on the former, not leaves it behind. This point of view has been indicated as the age of *integration* where more complex and multiple perspectives build on the still available previous ways of thinking. Borys et al. (2009) claimed that a new age must be mentioned by the name of *adaptation age* where all other ages are transcended without being discounted, it is beyond integrating the past. In a most recent organization of ages of safety, Özkan and Lajunen (2011) focused on a broader perspective including organizational factors as well. According to their point of view, 'safety culture period' is the fourth age of safety where person

(i.e., the role of human factors in traffic accidents) and environment (i.e., the structure of the complex multilevel socio-cultural and technical environment of the traffic with its goals and mechanisms) are merged.

Characteristics and definitions

The discussion on the main characteristics and differences between organizational culture and climate mentioned in the previous sections might be applied for safety culture and climate concepts as well (see Wiegmann et al., 2004; Rundmo, 2000; Glendon & Litherland, 2001). For example, safety culture was stated to be more enduring whereas safety climate is a temporary state of an organization and being affected from the specific changes and characteristic of the organization (e.g., Wiegmann et al., 2004). These two concepts were indicated as complementary or operating at different levels besides being independent, or as two different approaches to the goal of determining the importance of safety within an organization (Guldenmund, 2010). According to some point of views, safety climate is not a concept to study as separated from safety culture. For some researchers they are so close to each other that, safety culture researches carried on solely by using questionnaires are called safety climate researches (see Guldenmund, 2007).

As it was in the case of organizational culture and climate, there have been plenty of definitions of safety culture and climate as well. Researchers studied on the definitions of these terms and tried to end up with differentiations on them. For example, after investigating a plenty of safety culture definition, Choudhry et al. (2007) indicated that most of the definitions mention about the beliefs, and each mentions about the way people think and/or behave in relation to safety. Nevertheless, the concepts of safety culture and safety climate are not clearly defined; their relationships to each other, cause, content and consequences are not clearly pointed out either (Guldenmund, 2010). The example definitions presented below might be seen to realize that how difficult it is to make the differentiation between those concepts in definitions:

Safety Culture is:

- "The product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that determine the commitment to, and the style and proficiency of and organization's health and safety management" (ACSNI, 1993, p. 23).

Safety Climate is:

- The objective measurement of attitudes and perceptions toward occupational health and safety issues (Coyle et al., 1995).

Multidimensionality of safety culture and climate

Since the beginning of safety climate research there have been many studies to investigate the dimensional structure of this concept (Parker et al., 2006; Guldenmund, 2010). Being the first researcher studying the concept of safety climate, Zohar (1980) conducted a literature review and demonstrated the following dimensions that safety climate has: *'perceived management attitudes towards safety, perceived effects of safe conduct on promotion, perceived effects of safe conduct on social status, perceived organizational status of safety officer, perceived importance and effectiveness of safety training, perceived risk level at work place,* and p*erceived effectiveness of enforcement versus guidance in promoting safety*' (p. 3). Since then, many studies have been conducted to determine the factor structure of safety culture and climate. At first glance the resulted dimensionality differed in terms of the dimensions and the number of the dimensions. Additionally, the attempts to end up with the same factor structure as a result of the studies conducted in similar kind of organizations were not successful (Coyle et al., 1995). Guldenmund (2010) indicated that this might be a result of conducting the researches in different sectors. Employees from different sectors might have different objects for their attitudes, for this reason different dimensions resulted from the studies conducted in different sectors like construction, energy and service are not much similar in terms of their content (see Cox & Cox, 1991; Coyle et al., 1995; Cabrera et al., 1997). Even the results of the studies conducted in similar companies were not able to replicate the previously found factor structures (Collins & Gadd, 2002; Guldenmund, 2000). Although the researches ended up with different factor solutions, there are some common factors appeared in most of the studies. The factor related to 'management',

for example, is the most replicated factor. Flin et al. (2000) mentioned about five broad common safety culture dimensions: *management* (i.e., management's commitment to safety), *safety system* (i.e., safety policies, safety equipment), *risk* (i.e., risk-taking behaviour, perceptions of worksite hazards), *work pressure* (i.e., work pace, workload), and *competence* (i.e., selection and training of the work force, assessment of worker competence).

Causal models on organizational safety culture and climate

There are different arguments about the time when the first safety culture and climate researches have been conducted. According to Guldenmund (2010) it goes back to 1951 when Keenan et al.'s introspective ratings of employees in an automotive plant were gathered. However, the concept of safety climate has been first introduced to the literature by Zohar (1980). Since then, it has been the subject of many researches (e.g., Guldenmund, 2010; Probst et al., 2008; Varonen & Mattila, 2000). A major shortcoming with most of safety culture models is the lack of their integration into general models of organizational culture (Choudhry et al., 2007). Guldenmund (2000) indicated that the causal models developed to understand the concept of safety climate in relation to the organizational variables do not focus on a causal chain, instead mention about some tentative relationships. Although there have been many developed models of safety culture and climate; it is very hard to say that these are satisfactory to understand these concepts. These facts uncover the need of overall satisfying model of organizational culture/climate.

The first actual model of safety climate functioning was developed by Glennon (1982) who operationalised safety climate as the perception of organizational reality. The model demonstrated the cause, content and consequences of safety climate in a very global way. The measurement mentioned within this model is partly a kind of attitude measurement. According to the model, there is a sequence of processes from organizational characteristics (e.g., structure, hazards, strategy) to organizational outcomes (e.g., services, accidents). In this model, organizational climate is in a direct relationship with behaviour or individual outcomes, has an indirect relationship with organizational outcomes.

In the model proposed by Guldenmund (2010) safety culture and climate were 'fused' as he described. This model was theoretically based on Schein's (1992) dimensions of culture. The model included three levels: *basic assumptions* (unconscious and relatively unspecific) at the base level; *espoused values* at the middle level including attitudes having specific objects (four objects were mentioned about for safety culture: hardware, software, people and behaviour). The last level which is the closest to the surface is *artefacts* (manifestations specific to an object). Accidents or incidents, various behaviours, and inspections might be some examples of manifestations. The researcher quoted his model as being loyal to the holistic structure of organizational culture by fusing culture and climate. He also suggested that different levels of the model might be studied separately. Accordingly, if safety is the studied concept, for example, basic assumptions do not have to be safety related. However, if safety is handled very seriously in an organization it might be possible to argue that some assumptions within that particular organization might provide a base or reference to safety.

After a variety of discussions and arguments on culture and climate concepts in organizational settings, the models like the one Guldenmund (2010) proposed would provide the researchers with a more precise understanding of the relationships between these concepts, as well as defining the way how they are placed in the complete system of safety. In their chapter, Özkan and Lajunen (2011) modelled traffic safety from a comprehensive and multi-level point of view. Culture and climate were indicated as two different but mutually inclusive concepts. Climate indicated to be the surface features of safety culture, or temporal state measure of it. In this model, accordingly, culture and climate has been proposed as two layers of culture that could operate consistently and harmoniously to minimize the exposure of people to dangers at each level of traffic culture (i.e., individual, organizational, group, national and socio-political). Both within and between layer and level interactions of active and latent conditions/failures are important for safety.

The present study does not aim to cover all the characteristics of a culture research, according to the most definitions of it. That is, more observable, behavioural aspects of organizational culture were studied. Although culture, as a more embracing concept, provides a frame of reference for the observable aspects with its basic

assumptions (see Ashkanasy et al., 2000; Guldenmund, 2010; Özkan & Lajunen, 2011), the detailed analyses of basic assumptions with multilevel way of data collection and analyses were not conducted in the present study. Thus, it is more feasible to call the present study as a climate study. As the literature indicated, climate studies should focus on "something (e.g., Zohar, 1980). For the present study, the climate for "safety" is studied basically.

1.9 Organizational safety culture/climate in relation to safe driving

As societies do, organizations have different cultures (Schein, 1992). In the case of organizational culture, the emphasis is on better or worse cultures, stronger or weaker cultures, and the 'right' kind of culture to end up with effective organizations (Schein, 1992). Strength of climate, which is the amount of agreement among employees, was emphasized as being related to some important organizational outcomes (Dickson et al., 2006; Schneider et al., 2002). Hofstede's (1998) six organizational culture dimensions showed that besides being influenced by employees' feelings and behaviours, organizational culture practices directly influence both behaviours and feelings. This was supported by some previous studies indicating that organizational culture is related to certain employee-related variables like satisfaction (Lund, 2003), and commitment (Sheridan, 1992), and to organizational performance (e.g., Ogbonna & Harris, 2000). Similarly, Steinwachs (1999) indicated that shared values in a group make people think and act similarly and, therefore, the culture of a group implies the behaviours of the people of that group. According to Wiegmann et al. (2004) in the organizations with a well established safety culture; beliefs, attitudes, and practices should emphasize minimizing the exposure of employees to hazards. In other words, any type of application including training, selection, work schedules, and use of equipment should be organized by taking employees' safety into account.

Several studies have shown that safety performance has been affected by safety climate (e.g., Clarke, 2006; Cooper & Phillips, 2004; Neal & Griffin, 2006), although this relationship has been indicated as weak by a number of researchers (e.g., Ashkanasy, 2000; Clarke, 2006; Guldenmund, 2010). Ostrom et al. (1993) stated that organization's socially transmitted beliefs and attitudes toward safety affect safety

performance. According to Neal et al. (2000), safety culture mediates the relationship between organizational culture and safety performance. Rundmo (2000) indicated acceptance of rule violation as a strong predictor of risky behaviour and showed that perceived management priority of safety over production is a significant predictor of non-acceptability of rule violations. Similar to this, Varonen and Mattila (2000) found that company's positive attitudes to safety and its safety precautions are negatively related to accident rate. Spencer-Oatey (2000) mentioned about the existence of the relationship between safety culture and accidents and added that this relationship is determinative, rather than being interpretative.

In a more recent study Christian et al. (2009) stated that positive safety climate enhance safety knowledge through on-the-job discussions and formal trainings. Safety climate positively influences safety performance behaviours through safety knowledge and motivation, and negatively influence safety outcomes. The results of their meta-analytic study revealed that both person and situation are important workplace safety related factors in such a way that if the workers are selected trained and supported to maximize safety motivation and safety knowledge, an increase in safe behaviours and decrease in frequency of accidents and injuries are observed. Depending on the studies mentioned above, it might be argued that safety culture and climate is a concept worth of studying in relation to professional driving and safety.

1.10 Group related factors of professional driving and safety: Different driver groups

Traffic settings include a great deal of drivers from different driver groups 'acting' on the roads at the same time. Those driver groups might be divided into two as non-professional drivers and professional drivers (e.g., bus, heavy vehicle, minibus, taxi, emergency car drivers). Although all driver groups obey the general traffic rules which are valid for any driver, some driver groups have some informal rules to follow as a result of which they might develop different driving styles and have different accident risks (Sümer & Özkan, 2002).

Some characteristics of specific driver groups might make them more prone to different type of dangers or had different characteristics. As an example, four-wheel

drivers committed more violations, errors and lapses as compared to car users (Bener et al., 2008). Emergency vehicles were most likely to be involved in crashes because of excessive speed, with taxis this situation was the least likely one (Clarke et al., 2005). Fleet cars and fleet commercial vehicles were relatively less likely to speed as compared to their non-fleet counterparts. Lorry drivers had a higher proportion of crashes resulted from close following and fatigue/illness. Taxi drivers were the only group showing over-involvement in crashes caused by deliberate recklessness or failure to correctly judge gaps in traffic before making a manoeuvre. Company car drivers on the other hand had more accidents on slippery roads, or while under the influence of alcohol, or while speeding, as compared with other professional driver groups. Bus drivers showed a higher proportion of close following and failure to precede crashes (Clarke et al., 2005). In their study, Charbotel et al. (2010) indicated that the increased severity of accidents among heavy vehicle drivers means that this group accounts for a higher percentage of drivers killed while at work.

Studies in general investigated the non-professional drivers or a specific driver groups, like taxi drivers (Rosenbloom & Shahar, 2007). Comparison of different driver groups in terms of their driving related characteristics has been a mostly untouched topic. However, according to the previous studies conducted on professional drivers it might be argued that such comparisons are needed to understand the nature and characteristics of driving for different driver groups.

1.11 Methodological considerations: Measuring driving, accidents and safety culture/climate

Socially desirable responding

The studies conducted with self-reports indicated that this way of data collection might result in inaccurate or biased data to some degree because of socially desirable responding. That is, participants might tend to give responses that make them look good. This might be in the form of ‘impression management’ or ‘self-deception’ (Paulhus, 1984; Paulhus & Reid, 1991). Impression management, being a situation related phenomenon, is close to lying and falsification, and in self-reports of traffic behaviour it might cause serious biases (Lajunen, 1997; Paulhus, 1984). Self deception on the other hand, is a factor that can be characterised as a positively

biased but subjectively honest self-description. This construct is not influenced by anonymity versus public context manipulation (Paulhus, 1984).

According to Lajunen and Summala (2003) the bias caused by socially desirable responding is very small in the DBQ responses when the respondents complete the questionnaires anonymously and cannot gain anything by giving embellished responses. Socially desirable answers could be observed in the report of accidents as well. It was indicated that a problem with the accident data might be forgetting or deliberate under reporting of accidents (Elander et al., 1993; Lajunen, 1997; Zohar, 2000). However, Lajunen et al. (1998b) reported that an individual's need for social approval and avoidance of social disapproval influences self reports of driving; and impression management should always be controlled for when investigating driving style by self-reports.

For the perceptual-motor skills high positive correlation was found with self-deception, but not with impression management. Accordingly it might be argued that as a measure of a person's perception of his/her perceptual-motor skill orientation, perceptual-motor skills of the DSI is prone to biases, such that the drivers with high trust of their vehicle handling skills actually over-rate their perceptual motor skills. That is a person may over-trust his/her motor skills and misinterpret the negative feed-back in driving. This may cause the drivers to have serious problems especially when the actual skills are insufficient. As a result, the literature shows that besides/apart from collecting self-report data some other ways of data gathering like checking the company records and archives might reveal objective, additional and various information on the variables of interest.

Accident frequency as a criterion for safety

Driver accident history has been used as a criterion for safety in plenty of studies concerning on-the-road individual differences of drivers. Using this kind of a criterion might have problems as well as advantageous of it. For example, accident history, as a correlate of driving has been collected via self-reports or from police statistics. The advantage of using self-report might be collecting minor accidents and getting more detailed information which may not be achieved by some other ways of data collection, like police statistics. However, comparison of self-report and statistics data have shown under-reporting of accidents. In addition police statistics are not free of

problems. Some accidents might not be included in the statistics if there are no injury or if they are minor accidents. Specific groups might be over represented, like older drivers, as a result of the characteristics which are not related to the risk of being involved in accidents (Elander et al., 1993; Evans, 1991). As Wahlberg et al. (2011) indicated state records typically have lower means as compared to self-reported accident data for the same drivers, over short time periods. It has been proposed that any comparison of predictive power between self-report and records data is therefore automatically confounded by this difference.

Some other variables were introduced as alternative criterion measures of road safety. For example, Brow (1990) argued that identifying the causes of error would be better than focusing on trying to predict past accidents, or assessment of error contributions to accident statistics. However, as the theoretical models have failed to provide such measures and because of the uncertainty of interpreting these measures without connecting them to safety, these measures have not been widely used in the research. Although the information obtained from accidents is important, it does not directly address the events and behaviours that might precede and/or contribute those accidents. Ticketable traffic offences (i.e., penalties) constitute a great deal of these events and behaviours (Bingham et al., 2006). Although all traffic offences are not recorded, the recorded offences might represent one of the most reliable crash risk indicators. This fact makes offences an excellent proxy measure of accident risk (Elliot et al., 2001; Rajalin, 1994). Although at the present time, as a simpler and self-evident criterion for safety, accident rate has still been used as the most popular criterion. Offences/penalties might also be included into the relevant research at least as an additional criterion.

Exposure as a demographic variable related to driving and safety

There have been a wide range of studies investigating the relationship between exposure, the degree to which a driver is exposed to the traffic situation and accident involvement (e.g., French et al., 1993; Holló et al., 2010). According to Maycock et al. (1991) exposure and accident involvement relationship is not a linear one, but a negatively accelerating curve with smaller increase in accident rate at higher level of mileage. Additionally, being related to many factors associated to driving, exposure has shown differences in terms of age and gender. For different age and gender

groups different results regarding the relationships between exposure and driving related variables might be observed (Blanchard et al., 2010; Huebner et al., 2006). Such that male drivers have higher mileage than female drivers on average (Stradling & Parker, 1996). In addition to its relationship with accident involvement, exposure has more complicated relationships on driving style and safety (Lajunen, 1997). For instance, being more exposed to driving had positive relationship with confidence in driver's own abilities; whereas had negative relationship with safety related concerns (Lajunen & Summala, 1995). In addition, greater exposure was positively related to offenses (Bingham et al., 2006).

As Lajunen (1997) indicated, effects of exposure on driving style and accidents depend on variety of factors like, type of roads driven (e.g., highway, in-city roads), time of the year and day (e.g., winter, holidays), purpose of driving (e.g. professional or non-professional driving). Although the studies resulted in mixed results in terms of relationship between exposure and the mentioned variety of factors; exposure, with its quality and quantity, should be taken into account for the accident involvement possibility. Ignoring the possible effects of such a variable might result in error variance reducing the true association between psychological variables and accident frequency (Elander et al., 1993; Laapotti, 2003; Maycock et al., 1991).

Tools/techniques used in safety culture and climate research

Using qualitative and/or quantitative data collection tools has been a big topic of discussion in the culture and climate research. Even the answers to the question of why culture research dominated previously emerging climate research might be related to the methodology of the climate research. As Schneider (1975) emphasized, based on more observable aspects and surveys as tools, climate research has missed the deeper psychology of organizations. Use of self-report survey results in culture and climate research had some problems according to researchers (Guldenmund, 2007). When the questionnaire results were compared with the data from other sources revealed mixed results (e.g., Clarke; 2006; Johnson, 2007). At the end it might be told that for safety climate study questionnaire results should be used together with other sources of data, and should not be used to end up with the final decision. In the same vein Glendon and Stanton (2000) mentioned about a triangulated methodology that would be used with safety culture

measurements. This method provides a multi-level analysis of safety culture with the application of techniques like interviews, surveys, audits and document analysis, etc.

Level of measurement and aggregation issues in safety culture and climate research

Another important methodological consideration is the level of measurement. In the early climate researches, a group level conceptualization has been taken although the concept was studied at individual level. It is possible to talk about three levels at which the scales could be classified. Individual level contains perceptual processes influencing behaviour at individual level and behavioural processes specific to the individuals. Culture research context does not give so much meaning to individual level variables. The second level is group level; where group level behaviours and processes are dealt with. The last and most broad level is organization level. At this level behavioural process taking place at the level of management, or team is dealt with. Level of theory means at which level generalization will be made, and it determines the level of measurement. However it is important to stress that the level of theory and level of measurement are different things. Climate is at a group or organizational level of theory for this reason the questions should address the issues at that levels (Guldenmund, 2010).

Raudenbush and Byrk (2002) indicated that one of the most common conceptual and technical difficulties in organizational research is aggregation bias. That bias can occur when a variable has different meanings and consequently different effects at different organizational levels. As James (1982) stressed, variables defined at the group or organizational level usually do not work well at individual level. The solution to this problem might be the use of multilevel modelling (Nezlek, 2008). However, as Guldenmund (2010) indicated, aggregating individual level data to organizational level does not guarantee that one would get information about attitude object existing at that level of aggregation.

1.12 Framework of the present study

The traffic system in a country organizes mobility by taking safety into account and minimizing the risk. Although the main goal in traffic is to maximize mobility and safety at the same time; for all drivers those two aspects might be in conflict in traffic settings (Elvik & Vaa, 2005; Evans, 2004; Hirsch, 2003). As proposed by Özkan and

Lajunen (2011), traffic safety culture/climate of the whole country might influence driving and safety of both professional and non-professional drivers who constitute a sample of road users of that particular country. In spite of the number of studies on self-reported attitudes and behaviours that influence accident risk for non-professional drivers, relatively little research has examined the self-reported driver behaviours of those who drive company sponsored vehicles and/or spend long periods of time behind the wheel (Davey et al., 2007; Sullman et al., 2002; Xie & Parker, 2002). Because of the nature of their task, for the professional drivers the conflict between mobility and safety might have a different nature with the effects of some additional factors. For the professional drivers, as different from the non-professional ones, safe driving is a situation that might be provided or shaped by the organization, at least partly (Caird & Klein, 2004). For the employees working for an organization there is a 'system of organization' as well, where different structured/unstructured or formal/informal organizational characteristics and aspects might play roles and have effects on its employees. However, the role of organizational culture and climate in professional driving and safety, by considering their relationship with other driving related factors as well, remained mainly unexamined.

The framework of multi-level socio-cultural and technical environment of traffic proposed by Özkan and Lajunen (2011) pictures how factors from different levels of the general system might play role in driving and safety on roads. According to this framework, there are environment related (eco-cultural-socio-political, national, group, organizational, and individual) and person related factors (human factors, roads, engineering) concerning traffic settings. The level of safety is mostly determined by the way and the degree that these factors influence each other directly or indirectly, which in turn affect exposure and accident risk. The environment related factors at different levels are not equally associated with the person related factors. For example, the effects of geography or climate, as relatively more constant variables, might be more direct on engineering as compared to their effects on human factors. Also, within and between level interactions among the variables are possible. For example, it was proposed that culture of an organization will be largely determined by external factors or conditions like, national and regional factors; and

by the educational, social, economical and religious background of the employees (Schein, 1992; Guldenmund, 2010). Being in a different driver group (e.g., professional/non-professional or taxi, bus, heavy vehicle driver) might result in following informal rules of own group apart from or in addition to the general rules of traffic (Sümer & Özkan, 2002). Additionally, for the professional drivers, organizational factors, like culture/climate, might be more important than the formal traffic rules from time to time or situation to situation. As a result of the relationships among different variables at different levels, variances in driver behaviours and accident risks might be observed.

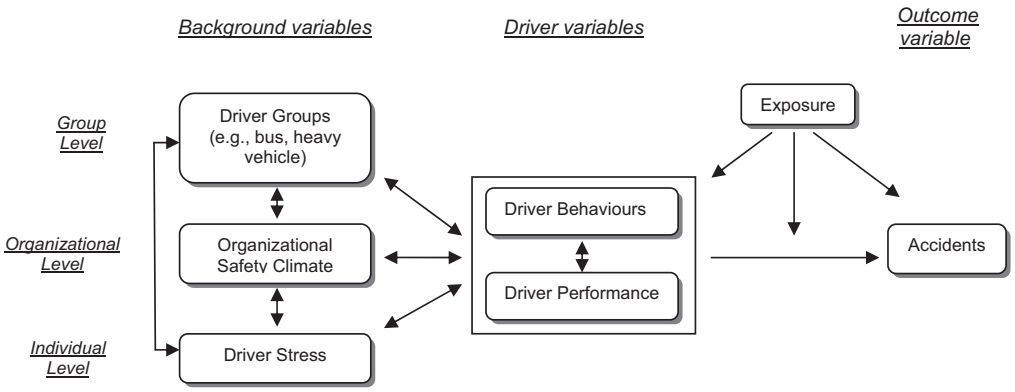

Figure 1. General framework for the relationships among environment related factors (group, organization, driver stress), human factors and accidents (adapted from Özkan, 2006)

Figure 1 shows the framework of the present study. According to this framework, driver groups, organizational safety climate and driver stress as group, organization and individual level background/environmental factors, are in relation to the human factors of driver behaviours and performance, and with outcome variable of accident. This framework implies that within level factors (safety climate, driver groups and driver stress; driver behaviours and performance) are also in relation to each other. It is assumed in the present study that, with its comprehensive point of view, grounding on such a framework to investigate the nature and direction of the relationships among the variables of interest is appropriate.

Guldenmund (2010) argued that culture cannot be understood only from certain behaviours, practices or characteristics; expressions like behaviours are only partly determined by culture, and partly by the circumstances. However, culture provides a

frame of reference for these practices. While investigating professional drivers the present study has emphasized the organizational approach via a cultural frame of reference. That is, by putting emphasize on organizational safety climate the present study investigated professional driving and safety. In addition to safety climate, driver groups (both professional driver groups and non-professional drivers) and driver stress have been included in the framework as an environment related factor and being in relation to the other variables of interest.

In summary, the framework mentioned in the present study might provide insight to the relationships among environment related factors, human factors and outcomes regarding professional driving from an organizational point of view and by considering the group related factors (i.e., different driver groups). Understanding the nature of such relationships has been indicated as a need in the previous literature as well. Such that, both understanding the relationship between work related factors, human factors and outcomes (e.g., Haworth et al., 2000); and investigation and comparison of different driver groups in terms of on-the-road characteristics, performance and safety (e.g., Rosenbloom & Shahar, 2007) have been emphasized as crucial in the literature.

1.13 Aims of the present study

In general, the present study aimed to investigate the nature of the relationships among safety climate, human factors in driving, driver stress, risky driving and accidents in the context of professional driving.

More specifically, the study has the following objectives of:

- Investigating the differences among driver groups (taxi drivers, minibus drivers, heavy vehicle drivers, and non-professional drivers) in terms of stress reactions, speeding, penalties and accident involvement (Sub-study I).
- Investigating the relationships between driver stress and risky driving including speeding, penalties and accident involvement (Sub-study I).
- Development of a safety climate scale specific to professional drivers (Sub-study IV).

- Investigating the relationships among safety climate and professional drivers' driver behaviours, performance and accident involvement.
    - The relationships between safety climate and driver behaviours of professional drivers were investigated (Sub-studies II, III, IV).
    - The relationships between safety climate and driver performance of professional drivers were investigated (Sub-study IV).
    - The relationship between safety climate and accident involvement of professional drivers was investigated (Sub-study III).

2. METHOD

2.1 General outline of the study

The present study included four sub-studies. The sample of the sub-studies consisted of professional and non-professional male drivers. The professional drivers were from different driver groups (i.e., taxi, minibus, bus, and heavy vehicle drivers). The data was collected via questionnaires for all sub studies, and both descriptive and inferential statistical analyses were conducted to analyse the data. Before providing more detailed information, Table 1 proposes overall information about the participants, measures and the statistical analyses used in each sub-study.

Table 1. General information about the sub-studies of the present study.

	Participants*	**Measures**	**Statistical Analyses****
Sub-study I	A total of 234 professional non-professional male drivers	The Driver Stress Inventory Demographic Information Form	Bivariate Correlation Analysis of Covariance Hierarchical Regression Logistic Regression
Sub-study II	A total of 230 professional male drivers	The Driver Behaviour Questionnaire Hofstede's Organizational Culture Scale Demographic Information form	Factor Analysis Bivariate Correlation Analysis of Covariance

Table 1. cont.

	Participants*	Measures	Statistical Analyses**
Sub-study III	A total of 73 professional male drivers	The Driver Behaviour Questionnaire Organizational Safety Culture Scale Demographic Information Form	Factor Analysis Bivariate Correlation Hierarchical Regression
Sub-study IV	A total of 223 professional male drivers	The Driver Behaviour Questionnaire The Driver Skill Inventory Transportation Companies' Climate Scale Demographic Information Form	Factor Analysis Bivariate Correlation Hierarchical Regression

** For the sub-studies II and IV, the same dataset was used.* ** All analyses were conducted by using the *statistical package SPSS (SPSS Inc, Chicago IL)*

2.1.1 Participants and procedure

Sub-study I

In the first Sub-study, taxi drivers (N = 69); minibus drivers (N = 63); heavy vehicle drivers (N = 64); and non-professional drivers (N = 38) participated. Table 2 provides the demographic information concerning the variables of interest of Sub-study I.

Table 2. Mean and Standard Deviation (SD) values of age, annual mileage, period of driving license, and number of accidents for the four driver groups involved in the study

	N	Age		Annual Mileage		Age of Driving License		Number of Accidents *(within the last three years)*	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Taxi	69	39.09	11.57	53.920	46.666	17.56	10.37	1.09	1.72
Minibus	63	41.41	9.77	55.431	33.312	18.11	8.00	1.57	3.69
Heavy Vehicle	64	38.56	8.07	95.481	124.555	17.63	6.913	1.37	2.13
Non-Prof.	38	39.71	11.89	17.247	217.798	15.66	9.533	1.21	4.84

Sub-study II and Sub-study IV

For Sub-study II, a total of 230 professional drivers from eight different public and private people/good transportation companies participated in the study. The mean age of the drivers was 39.2 years (SD = 7.96), the average annual mileage was 91,557 km (SD = 43,142, range = 10,000–160,000 km) and they had driven 17.7 years on average. Although the data set used for the Sub-study IV is the same with the one used for Sub-study II, for the latter one, the data from 223 of the 230 male professional driver participants was included in the analyses because of missing data on some scales used in Sub-study IV. The professional drivers included in Sub-study IV had the mean age of 39.16 years (SD = 7.96) and the average annual mileage

(the distance has been driven) of 100.37 km (SD = 48.65, range = 12.000-190.000 km). The participants had driven 17.7 years in average and the mean number of accidents they had been involved within the last three years was 0.77 (SD = 1.36).

Sub-study III

The Sub-study had a total of 73 professional male driver participants (38 taxi drivers and 35 cargo company drivers). The mean age of the drivers was 35.18 years (SD = 7.12) and the average annual mileage was 74.080 km (SD = 73.072). The participants had 13.6 years of mean driving experience, and the mean number of accidents they were involved was 1.33.

Procedure

For all Sub-studies, the same recruitment methods were applied to recruit the participants from different driver groups in order to eliminate the possible sampling bias. The professional drivers were recruited first by contacting their companies/employees for permission, and then they were individually asked to participate in the study. The non-professional drivers, in Sub-study I, were directly asked to participate in the study. All the participants participated in the study upon their personal acceptance. The participants were assured about confidentiality and not compensated for their participation in the study.

2.1.2 Measures

Demographic variables: Demographic information form

The participants of the Sub-studies were asked to provide information on age, annual mileage, years a full driving license is held, number of accidents, type of accidents, frequency and the type of penalties. Type of accidents information was collected for work hours and out of work hours separately; both passive and active accidents within the last three years were asked to be reported. The question to gather the related information was: ‘within the last three years how many times did you have an accident without considering seriousness of it?’ Considering penalties/offenses the information was gathered on parking, speed violation, overtaking and any other kind of penalties that the driver had within the last three years. The question to gather the related information was: ‘How many times did you get the following traffic penalties

within the last three years?' For speeding, both in-city and highway roads were focuses while collecting the data via the question of 'under normal weather and road conditions how fast do you drive on in-city/highway roads on average?' The total number of accidents and penalties were measured via the demographic information form, because it was the only possible way to gather data on different types of accidents.

Driver behaviours: The Driver Behaviour Questionnaire (DBQ)

The DBQ was used in Sub-studies II, III, and IV to collect driver behaviour data from professional drivers. To measure the *violations* and *errors*, the DBQ with extended violations scale was used. Only the *violation* and *error* scales of the DBQ were used, because the lapses are not critical for safety and are mostly relevant only for the elderly drivers (Parker et al., 2000). The Positive Driver Behaviours Scale (Özkan & Lajunen, 2005), which was developed to measure driver behaviours conducted with positive intentions, was also used together with the DBQ. The Turkish translation and the factor structure of the DBQ have been validated in studies conducted among both professional (Sümer & Özkan, 2002) and non-professional drivers (Sümer et al., 2002). The participants were asked to evaluate each item on a 6-point Likert-type scale (1 = never, 6 = always). Cronbach's Alpha internal consistency scores of the *errors, violation,* and *positive driver behaviours* scales for the Sub-studies II, III, and IV were as follows respectively: 0.89, 0.79, 0.89 for *errors* (8 items); 0.91, 0.85, 0.92 for *violations* (13 items); and 0.92, 0.89, 0.92 for *positive behaviours* (8 items).

Driver performance: The Driver Skill Inventory (DSI)

The DSI was used in Sub-study IV to gather driver performance information. The short version of the DSI which was used in the present study is a 10-item self-report measure of *perceptual-motor* (including 5 items; e.g. 'fluent driving') and *safety skills* (including 5 items; e.g. 'avoiding unnecessary risks') (Lajunen & Summala, 1995). Drivers were asked to rate each item on a 5-point Likert-type scale (0 = very weak, 4 = very strong). For the present study, Cronbach's Alpha for internal consistency scores for the *perceptual-motor skills* and *safety skills* dimensions were 0.61 and 0.70, respectively.

Driver stress: The Driver Stress Inventory

Forty eight-item version of the Driver Stress Inventory was used to measure stress reactions of the drivers in Sub-study I. The original factor structure of the Driver Stress Inventory was applied in the present study. The Driver Stress Inventory includes five distinct dimensions of stress vulnerability. These dimensions are *dislike of driving* with 12 items (e.g., I feel tense or nervous when overtaking another vehicle), *aggression* with 12 items (e.g., I really dislike other drivers who cause me problems), *fatigue proneness* with 8 items (e.g., I become inattentive to road signs when I have to drive for several hours), *hazard monitoring* with 8 items (e.g., I make an effort to look for potential hazards when driving), and *thrill seeking* with 8 items (I get a real thrill out of driving fast). The participants were asked to evaluate each item on a 10-point scale.

Organizational safety climate

Sub-study II: Hofstede's Organizational Culture Scale

The original scale consists of 43 items measuring six organizational culture dimensions: *process oriented versus results oriented; employee oriented versus job oriented; parochial versus professional; open versus closed; loose versus tight; normative versus pragmatic*. Hofstede (1998) determined three items for each dimension as the key indicators for that dimension. In the present study, these 18 items were used for measuring the six organizational culture dimensions. The participants were asked to evaluate each item on a 5-point Likert type scale (1 = strongly disagree, 5 = strongly agree). After conducting factor analyses, two-factor solution was ended up. The factors were named as *work orientation* and *employee consideration.* Cronbach's alpha internal consistency reliabilities for these two scales were 0.79 and 0.68, respectively (see Sub-study II for more detailed information on the scale).

Sub-study III: Organizational Safety Culture Scale

An organizational safety culture scale was developed within Sub-study III to collect information about the drivers' perceptions of the safety culture of the company in which they were working. The scale consisted of 15 items measuring three safety culture dimensions of *traffic safety*, *general safety*, and *work safety* (see Sub-study III

for more detailed information on the scale). Internal consistency reliabilities for these three factors were 0.85, 0.74, and 0.92, respectively. The participants were asked to evaluate each item on a 5-point Likert type scale (1 = 'strongly disagree', 5 = 'strongly agree').

Sub-study IV: Transportation Companies' Climate Scale (TCCS)

Scale development: Transportation Companies' Climate Scale – the TCCS (Sub-study IV): In the process of development of the TCCS a comprehensive literature search was conducted to find out the studies on safety culture/climate, and the studies targeting different sectors were reviewed to figure out the main dimensions of safety culture/climate in general, and statements/items placed under those dimensions. Among these statements/items the ones that can be adapted into the safety culture/climate scale to be used for professional drivers were selected by the last two authors of the Sub-study IV. Previously determined main dimensions were differentiated as safety climate and safety culture dimensions and the selected items were placed under the dimension that they are belong to. In addition to the evaluations of the two authors of the Sub-study IV, the listed safety climate dimensions and items were also evaluated in a panel including professional drivers (N=2) and their manager in terms of items' importance and frequency in relation to the task (i.e., driving as a professional driver in a company). The evaluators were asked to add new items if they consider it necessary to do so. As a result, sixty-one items were indicated to be the important ones for measuring transportation companies' climate. After that, the same evaluators were asked to determine the dimensions which are important for transportation companies climate and this process culminated in the following dimensions: *safety management and organizational commitment to safety, job security and safety concerns, specific prevention strategies for safety, work and time pressure, safety communication in trip, passengers/customers' commitment to safety, drivers' commitment to safety in trip, reward system for safe trip, selection of drivers for safe trip, training of drivers for safe trip, and control/check points during the trip.* On the next step, the same group of evaluators were asked to classify these dimensions into categories in terms of their relevance to the main tasks of drivers and companies' 'ways of doings' in transportation. Two main categories were obtained and named as Policy-focused

Safety Orientation (PfSO), and Transport/Trip-focused Safety Orientation (TfPO). Next, the same evaluators were asked to classify the sixty-one items within one of the PfSO or TfPO categories. Lastly, they were asked to decide which item should be placed under which factor within the category.

In the present study the PfSO dimensions including thirty-three items were included. The scale including 31 of those 33 items was named as the TCCS in the Sub-study IV, and included three dimensions of *general safety management, specific practices and precautions, work and time pressure* (see Sub-study IV for the items of the TCCS). The drivers were asked to evaluate each item on a 5-point Likert type scale (1 = strongly disagree, 5 = strongly agree). Cronbach's Alpha for internal consistency scores for the *general safety management, specific practices and precautions, work and time pressure* dimensions were 0.92, 0.82, and 0.78, respectively.

3. RESULTS

3.1 Comparison of professional and non-professional driver groups in terms of stress reactions, speeding, number of penalties and accident involvement (Sub-study I)

After controlling the effects of age and annual mileage, ANCOVA results for stress reactions indicated differences between different driver groups in three dimensions of the Driver Stress Inventory (see Table 3). Minibus drivers were more aggressive compared to the non-professional drivers. Non-professional drivers were better in hazard monitoring in traffic compared to the minibus and heavy vehicle drivers. Finally, heavy vehicle drivers reported more fatigue proneness compared to non-professional drivers. There were no significant differences among different driver groups on dislike of driving and thrill-seeking.

Table 3. ANCOVA results for the sub dimension of the Driver Stress Inventory

	Non-Professional	Heavy Vehicle	Taxi	Minibus	F
Aggression	48.22[a]	53.93[ab]	55.71[ab]	62.49[b]	4.95*
Hazard Monitoring	64.29[a]	51.36[b]	56.62[ab]	52.05[b]	4.40*
Fatigue Proneness	41.56[a]	56.68[b]	50.69[ab]	51.46[ab]	3.90*
Dislike of Driving	33.64	29.60	33.29	30.94	1.04
Thrill-seeking	34.77	42.28	41.18	48.18	1.98

Note: *Bonferroni correction was used for pairwise comparisons. Mean values with different superscripts within rows are statistically different from each other. *p<.01. Range of the scale scores: 0 - 100.*

Results of the ANCOVAs revealed group differences in speeding and number of penalties. As Table 4 shows, ANCOVA results for speeding and number of penalties revealed that the non-professional drivers drove faster than the heavy vehicle, taxi, and minibus drivers on highways, and faster than the heavy vehicle and minibus drivers on in-city roads. Besides, the minibus drivers reported more penalties than the heavy vehicle and non-professional drivers. There were no significant differences among different driver groups in accident involvement.

Table 4. ANCOVA results for speeding and number of penalties

	Non-Professional	Heavy Vehicle	Taxi	Minibus	F
Speeding on Highways	106.45^{a}	89.35^{b}	95.28^{b}	96.01^{b}	7.97**
Speeding on In-City Roads	62.94^{a}	53.72^{b}	56.62^{ab}	53.24^{b}	3.80*
Number of Penalties	1.54^{a}	1.09^{a}	1.58^{ab}	2.39^{b}	3.54*

*Note: Bonferroni correction was used for pairwise comparisons. Mean values with different superscripts within rows are statistically different from each other. *p<.05, **p<.001*

3.2 Relationships between driver stress and risky driving including speeding, penalties and accident involvement (Sub-study I)

Relationships among the Driver Stress Inventory dimensions and variables of interest (i.e., speeding, penalties, and accidents) were investigated via two sets of regression analyses. In the first set of regression analyses, number of accidents and number of penalties were used as the dependent variables. In these logistic regression analyses, age and annual km were entered in the first step, and the driver group was entered in the second step. After controlling the effects of these variables the effects of the Driver Stress Inventory dimensions were entered in the third step. As a result, aggression (B= 0.04, SE = 0.02, $Wald$ = 6.04, $p < 0.01$), dislike of driving (B= 0.03, SE = 0.02, $Wald$ = 4.34, $p < 0.05$), and hazard monitoring (B= 0.04, SE = 0.01, $Wald$ = 9.10, $p < 0.001$) dimensions were related to accident involvement. Accidents were more frequently reported by the drivers with higher aggression, dislike of driving and hazard monitoring scores. None of the dimensions were related to the number of penalties.

In the second set of regression analyses, speeding on in-city roads and on highways were used as the dependent variables. The Driver Stress Inventory dimensions were forced into the model. The results of the hierarchical regression analyses indicated

that aggression (β= 0.25, $F(5, 234) = 4.47$, $p<0.05$) and thrill-seeking (β= -0.33, $F(5, 234) = 4.47$, $p<0.01$) were related to speeding on in-city roads. Drivers reported higher speeds on in-city roads when they have high aggression scores whereas slower speeds on in-city roads were reported by the drivers with higher thrill-seeking scores.

3.3 Factor structure of safety climate for professional drivers (Sub-studies II, III, IV)

In the present study, in three of the four Sub-studies factor structures of safety climate scales were investigated. In Sub-study II, a previously developed organizational safety culture scale (Hofstede, 1998) has been used. For the Sub-studies III and IV the scales specifically developed for professional drivers were used. The factors derived from the factor analyses conducted within the three Sub-studies were presented in Table 5.

Table 5. Factors determined for each sub-study after the factor analyses.

Sub-study II	Sub-study III	Sub-study IV
Work Orientation (7 items)	Traffic Safety (7 items)	General Safety Management (16 items)
Employee Consideration (9 items)	General Safety (3 items)	Specific Practices and Precautions (8 items)
	Work Safety (5 items)	Work and Time Pressure (7 items)

Note: For the items loaded into the factors original publications should be seen

In Sub-study II, internal consistency reliability analyses showed remarkably low (range: 0.34–0.76) Cronbach's Alpha values for internal consistency (Tabachnick & Fidell, 2007) for the original version of Hofstede's Organizational Culture Scale (Hofstede, 1998) with six dimensions (*process oriented versus results oriented; employee oriented versus job oriented; parochial versus professional; open versus closed; loose versus tight; normative versus pragmatic)*. To compute more reliable scales, principal component factor analyses were performed for the 18 items of these six dimensions. The number of factors was determined by using eigen values, the scree plot and the parallel analysis. A factor loading value of 0.30 was determined as the cut-off score for including the item into the scale. As a result, a two-factor solution was found to be the most interpretable one. The first factor was named as *work*

orientation considering the content of the items in this dimension. This factor included seven items, and explained 25.6% of the total variance. *Work orientation* refers to the importance given by the organization to the work being done, the result of the work, the working style of the employees, and the rules for doing specific work related tasks. The second factor was named as *employee consideration*. This factor included nine items, which accounted for 9.7% of the total variance. *Employee consideration* refers to the degree to which employees are considered as individually important, are involved in decision making processes and their adaptation to the organization is considered important. Cronbach's alpha internal consistency reliabilities for these two scales were 0.79 and 0.68, respectively.

For both Sub-studies III and IV, factor analyses with principal axis factoring method were conducted and the number of factors was determined by using eigen values (eigen values>1.0 were acceptable), factor loadings (value of 0.30 was determined as the cut off score), the scree plot and the conceptual relevance of the items to the dimension that they are loaded. Additionally, for both Sub-studies, factor analyses revealed three-factor solutions as the best solution. In Sub-study III, the first factor was named as *traffic safety*. This factor included seven items, and accounted for 39.4 per cent of the variance. The second factor was named as *general safety* and included three items accounting for 9.1 per cent of the variance. The third factor was named as *work safety* and it included five items, which accounted for 5.4 per cent of the variance. Internal consistency reliabilities for these three factors were 0.85, 0.74, and 0.92, respectively. *Traffic safety* is related to technical traffic related issues like monitoring the newly applied traffic rules and regulations, technical service check of the vehicles, providing the drivers with first aid information. *General safety* is related to the distribution of work load and time pressure under normal and urgent conditions. *Work safety* has aspects related to the general use of all equipments and sources for the purpose of work safety, as well as the aspects on the control regarding obeying those work safety related rules and regulations.

In Sub-study IV, the first factor was named as *general safety management* because the content of the items were about the safety commitment within the organization in a general and at a broader level. The drivers' general perceptions about the applications, rules and regulations which might constitute base for the more detailed

ones were mentioned. This factor included 16 items, and explained 30.35 of the total variance. The second factor was named as *specific practices and precautions*. The content of the items emphasized more detailed and specific safety related applications and prevention strategies within the organization. This factor included 8 items, which accounted for 10.13% of the total variance. The third factor was named as *work and time pressure*. The items loaded in this factor were directly related to the pressure that the drivers felt related to the work itself and being on time. That is, within this dimension work and time pressure aspects of safe driving were emphasized specifically. This last factor included 7 items, which accounted for 6.52 of the total variance.

3.4 Safety climate in relation to driver behaviours of professional drivers (Sub-studies II, III, IV)

ANCOVAs and hierarchical regression analyses were conducted to investigate the relationship between safety climate and driver behaviours of professional drivers within three Sub-studies of the present study. The 2X2 ANCOVAs, in the Sub-study II, were conducted to test whether mean differences in the DBQ dimensions (errors, violations and positive driver behaviours) between safety climate groups (high versus low work orientation/employee consideration) are significant after removing the effects of covariates (age, annual mileage and organization types). The safety climate groups were ended up as a result of the factor analysis of Hofstede's six organizational culture dimensions. In each of three ANCOVAs, work orientation (low versus high) and employee consideration (low versus high) dimensions of organizational climate were the independent variables; age, annual mileage and organization type variables were treated as the covariates. Results of the ANCOVA analyses revealed significant main effect of work orientation on error scores, $F(1, 124) = 6.14$, $p<0.05$, and violation scores, $F(1, 124) = 5.16$, $p<0.05$, but not for positive driver behaviours. Drivers with low scores of work orientation reported significantly higher frequencies of errors and violations as compared to the drivers with high scores of work orientation. It was also found that drivers with low scores of employee consideration reported higher frequencies of errors and violations compared to the drivers with high scores of employee consideration. The interaction test revealed significant results for violations, $F(1, 124) = 3.93$, $p<0.05$. It was found

that the effects of work orientation on violation scores are different for different levels of employee consideration.

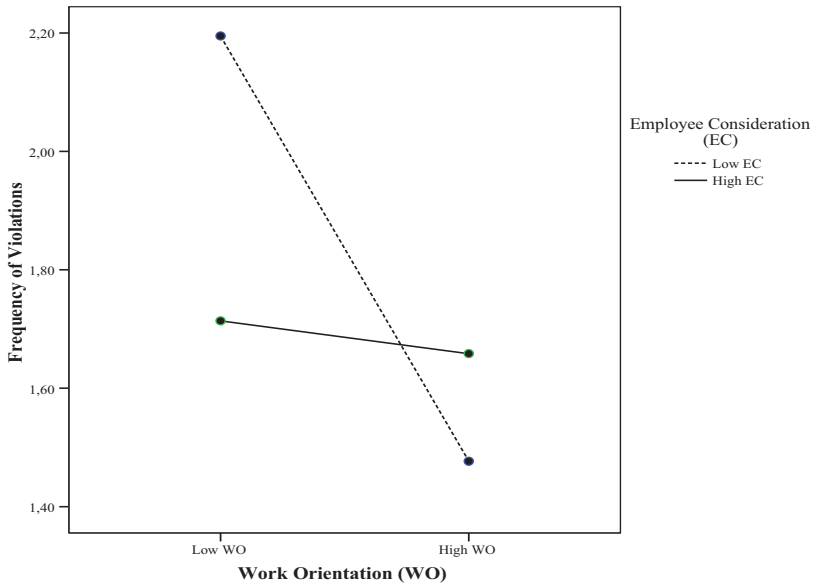

Figure 1. The interaction between organizational climate dimensions (Work Orientation and Employee Consideration) on violations.

As Figure 1, explains, the highest frequency for violation was reported when both work orientation and employee consideration scores are low (i.e., low organizational importance on the work being done, rules and regulations, etc.; and the employees are given less consideration for their presence in and adaptation to the organization, etc.). The lowest violation frequencies were reported when work orientation scores are high but employee consideration scores are low (i.e., high organizational importance on the work being done, rules and regulations, etc.; but the employees are given less consideration for their presence in and adaptation to the organization, etc.).

In Sub-studies III and IV, hierarchical regression analyses were performed to investigate the relationship between safety culture and driver behaviours. In each analysis, effects of age and mileage were controlled by forcing them into the model at the first step. In the second step, safety climate dimensions were entered into the model. For the Sub-study III, t*raffic safety* dimension of climate was negatively related to violations ($\beta = -0.50$, $F(5, 73) = 2.87$, $p<0.01$). *Work safety* dimension was

positively related to both violations (β= 0.37, $F(5, 73) = 2.87$, $p<0.05$) and errors (β = 0.40, $F(5, 73) = 3.47$, $p<0.01$). *General safety dimension* was negatively related to errors (β = -0.34, $F(5, 73) = 3.47$, $p<0.01$). That is, when organization is perceived as emphasizing safe driving, by following traffic rules and regulations, monitoring technical service check of the vehicles and applying training programs for safe driving, drivers reported to have low frequencies of violations. When the drivers think that safety related policies, applications, attempts, and controls within the organization are strong, and the equipments are used for the purpose of work safety they reported more frequent errors and violations. Errors were reported less frequently by the drivers of organizations where work load and time pressure arrangements are made considering safety into account. In the Sub-study IV, safety climate dimensions of *general safety management, specific practices and precautions,* and *work and time pressure* were investigated regarding their relation to driver behaviours. The results revealed that only *work and time pressure* was related to violations (β = -0.40, $F(5, 223) = 6.38$, $p<0.001$) and errors (β = -0.33, $F(5, 223) = 4.05$, $p<0.001$). When work and time pressure is given high importance within the organization, less frequent errors and violations were reported.

3.5 Safety climate in relation to driver performance of professional drivers (Sub-study IV)

In Sub-study IV, hierarchical regression analyses were conducted to investigate safety climate in relation to *perceptual-motor skills* and *safety skills* dimensions of driver performance. In order to control for the statistical effects of age and annual mileage, these two variables were entered into the model in the first step. In the second step, *general safety management, specific practices and precautions*, and *work and time pressure* dimensions of safety climate were entered into to the model. The results revealed that only *general safety management* was related to safety skills (β = 0.24, $F(5, 223) = 7.06$, $p<0.001$). When organization‘s commitment to safety is high and it is performed into the general safety management practices, drivers reported to have stronger safety skills.

3.6 Safety climate in relation to accident involvement of professional drivers (Sub-study III)

In order to investigate the relationships between organizational safety climate and accidents of professional drivers, multiple regression analysis was conducted. In the analysis, effects of age and mileage were controlled by forcing them into the model at the first step. In the second step, organizational safety climate dimensions were entered into the model. According to the results of regression analysis both *traffic safety* (β = -0.30, $F(5, 73) = 1.89$, $p<0.05$) and *general safety* (β = -0.29, $F(5, 73) = 1.89$, $p<0.05$) dimensions of climate were negatively related to accidents. When organization is perceived as emphasizing safe driving, by following traffic rules and regulations, applying training programs for safe driving, and work load and time pressure arrangements are made considering safety into account, drivers reported to have less frequent accidents.

4. DISCUSSION

Comparison of different professional and non-professional driver groups

Concerning the differences between professional and non-professional drivers, results supported earlier findings indicating that these two groups of drivers differ in their stress reactions and risky driving behaviours (e.g., Matthews et al., 1999; Rosenbloom & Shahar, 2007). The present study indicated that non-professional drivers drove faster on both in-city roads and highways as compared to the taxi, minibus and the heavy vehicle drivers; they also were better in hazard monitoring in traffic as compared to the minibus drivers and heavy vehicle drivers. Whereas heavy vehicle drivers reported more fatigue proneness as compared to the non-professional drivers. Depending on the literature, these results might have explanations regarding the effects of variety of factors (e.g., type of the vehicle, work pressure for professional drivers, other stress factors for both groups of drivers). It is clear from the results that ending up with the mentioned differences between non-professional and professional drivers, whereas not within professional driver groups show that some characteristics related to professional driving, regardless of the group the drivers belong to, create difference making them different from non-professional

drivers. The need to investigate professional drivers in terms of their characteristics and factors related to that group has been emphasized once more.

According to the results of the Sub-study I, concerning the differences for different professional driver groups, the only significant difference was obtained for minibus and heavy vehicle drivers on the frequencies of penalties; the minibus drivers reported more penalties as compared to the heavy vehicle drivers participated in the study. Minibus drivers are transporting passengers; in some places they carry about fifteen people at once and while driving they have to stop many times for passengers to leave or get in. There are also some extra traffic rules for minibus drivers in Turkey, they have different time schedules, and any problems with not obeying such rules or trying to catch up with the time schedule might result in additional risky traffic behaviours (Karasek & Theorell, 1990). Another explanation might be related to the fact that heavy vehicle drivers who do very different type of transportation compared to minibus drivers, drive mostly on highways, not on in-city roads. This fact might influence the frequency of penalties, as there are different penalty related rules for in-city roads and highways. Additionally, different traffic situations take place on highways and in-city roads which might lead up to different probabilities of having penalties. That is, the type of exposure as well as the amount of it should be taken into account as well.

Considering the stress reactions-risky driving relationship, aggressive drivers had higher speed on in-city roads and involved in higher number of accidents, as congruent with the findings indicating associations between aggression and some deliberate violations like speeding (e.g., Matthews et al., 1997). Similarly, regression analyses revealed that drivers with high dislike of driving scores were involved in higher number of accidents. According to Matthews (2001), high dislike of driving scores may interfere with task performance because it might generate negative mood states. By nature, high scores on the thrill-seeking and hazard monitoring dimensions of the Driver Stress Inventory should be related to more risky driving style and being aware of danger faster, respectively. However, the results of the present study indicated that drivers with high thrill-seeking scores drove slower on in-city roads and that the drivers with high hazard monitoring scores were involved in higher number of accidents. Different explanations are possible for these unexpected results. For

example, effects of some other factors, like risk perception, and overestimation of hazard perception might explain these results. High level of thrill-seeking could be expressed as over speeding only on the certain types of roads (i.e., motorway). In summary, the present study showed that professional drivers are more prone to stress reactions in traffic and to commit more frequent risky traffic behaviours as compared to non-professional drivers.

Safety Climate in relation to driver behaviour and performance, and accident involvement

Considering the relationships between safety climate and human factors of driving, three sub-studies revealed significant and similar results. As for driver behaviours significant relationships were obtained for both errors and violations in three Sub-studies. In more detail, the studies indicated that as the organization gives priority to traffic and vehicle related factors, fewer violations were observed (Sub-study III). Similarly, when professional drivers reported the organization they are working for as arranging work load and job related time pressure by giving priority to safety, they reported fewer violations (Sub-study IV) and errors (Sub-studies III and IV). That is, if safety rules and regulations are strictly applied even in the case of time pressure, and the work load is arranged by taking safety of employees and passengers into account, fewer violations and errors appear to be committed. Results of the Sub-study II explained that, when professional drivers perceive their work environment as cost-conscious, having clear time schedules, etc., in other words, being high in work orientation, they reported lower frequencies of driving errors and violations. This result might indicate that clear internal structure brings clarity in discipline, control, application of the rules, and clarity of the jobs to organizations and to professional drivers working for those organizations (see Hofstede, 2001).

There was, also an interaction of work orientation and employee consideration on professional drivers' self-reported frequencies of violations. As the drivers reported that low consideration had been given for their place and presence in the organization, and when the organizational rules, structures, regulations and the work being done are loosely followed, they reported the highest frequency of violations. On the other hand, when the drivers reported that the style of work, rules and regulations were strictly controlled while they were given low consideration for their presence

within the organization, they reported the lowest frequency of violations. The results clearly indicate the importance of safety climate in safe driving and traffic safety. The stronger the work orientation cultures that transportation companies establish and enforce, the less frequent errors and violations appear to be committed. In the former result it can be inferred that a well structured work system encouraged the drivers to follow planned actions to achieve the intended consequences, as Reason et al. (1990) mentioned in defining errors. In the latter one, it is clear that if the drivers perceive the organization as 'loose' in terms of the approach to the work being done and lacking consideration for their personal place and value in the organization, they tend to be involved in a higher frequency of deliberate deviations from the practices believed necessary to maintain the safe operation of a potentially hazardous system, as Reason et al. (1990) defined violations. These results of the present study were in line with some earlier findings indicating that organizational culture has an impact on employee behaviour and outcomes (e.g., Øgaard et al., 2005; Schein, 1984). More specifically, Haworth et al. (2000) told that higher number of errors and higher levels of work pressure were found to be the predictors of work related accidents. That is, higher work pressure correlated with higher frequencies of errors. Another similar result provided by Vredenburgh (2002), who stated that if organization's cultural message is that production, not people or safety, is the priority, employees might perceive loose organizational safety, which, in turn, may affect their safety performance negatively. Rundmo and Hale (2003) conducted a study investigating an industrial company's managers' attitudes towards safety and accident prevention. Results indicated safety attitudes of managers (e.g., high safety priority, high risk awareness) to be important causal factors for their behaviour.

The last findings regarding the relationship between safety climate and driver behaviours infers positive relationships of high work safety with self-reported number of errors and violations (Sub-study III). In other words, if the drivers found company's safety regulations satisfactory, company's investment in safety sufficient, and think that safety has a priority, they reported more errors and violations. These results being in conflict with the previous literature might be influenced from the type of drivers included in the study. That is, the nature of the job and some task or job related characteristics, rather than climate, could be influencing the results for taxi

and cargo drivers. For example, structure of (e.g., time schedules) and power distribution within the organization (Antonsen, 2009) might be investigated in terms of their effects on driver behaviours. Hofmann and Stetzer (1998) indicated that communication, as an intervening variable, might be important in understanding safety related behaviours within organizations. In a similar vein, Westrum (2004) argued that culture seems to be strongly related to safety in such a way that the processes related to fixing the hidden problems seem to be strongly connected to detection, reporting, problem solving, and implementation, which are shaped with information flow within the organization, basically from leaders to the employees. For both taxi and cargo company drivers the structure and content of safety climate and accordingly the drivers understanding of climate might be different as compared to some other professional drivers. The taxi stops or cargo companies in Turkey are mostly questionable in terms of both being 'proper' organizations regarding their structure, and for the measurement of safety climate in the way it has been conducted within the present study. The present study has shown that even in such organizations where it is very difficult to mention about corporate characteristics it might be possible to talk about safety climate. However, the way safety culture and climate should be studied within such organizations, and the factors should be investigated together with or separately from safety climate might be important points to discuss for the future studies. Relating to the relationship between safety climate and positive driver behaviours, none of the sub-studies have resulted in significant results. It could be claimed that positive driver behaviours might be related to some internal factors like personality, attention capacity and information processing, rather than being related to the external factors like organizational climate.

Results of the Sub-study IV indicated that general safety management was related to safety driving skills of the professional drivers. Regression results showed that if the professional drivers perceive management as committed to create a safe work environment in general, if the management's general understanding within the organization is safety focused, the drivers reported higher safety skills and, hopefully, behave accordingly. As a result, it might be possible to argue that in such organizations, personnel related decisions like employment, disemployment, selection, rewarding, career development and training should emphasize hiring

drivers with higher safety skills, and trying to make the employees working for the organization to have higher safety skills through training. The regression analyses did not provide significant results for organizational safety climate's relationship with perceptual-motor skills. As in the case of positive driver behaviours, it could be claimed that perceptual-motor skills might be related to some other factors rather than safety climate.

The relationship between safety climate and accident involvement has been investigated in the Sub-study III. According to the results, general safety dimension of safety climate had a negative relationship with self-reported accidents. This finding is in line with those of Vuuren (2000), who evidenced that improvement in company's safety climate resulted in a significant decreases in accident rate. Similarly, Kirschenbaum et al. (2000) reported that hazardous working conditions increased chances of being involved in an accident. Moreover, Hayes et al. (1998) stated that positive employee perceptions of safety are related to low accident rates.

A tentative model: A route for the relationships among safety climate, driver behaviour and performance, driver stress and accident

According to the results from the previous literature, it is not easy to tell that we have enough information for the understanding of the nature of professional driving, the factors influencing this task, and the characteristics that could make professional drivers different from the non-professional ones at least regarding some aspects. Concerning that, it is possible to talk about the need for the development of models explaining professional driving in relation to driving related variables and outcomes. Depending on the results of the sub-studies included in the present study and support from the previous literature, a tentative model has been developed (see Figure 2). The model describes a route that factors from different levels influence each other and result in accident.

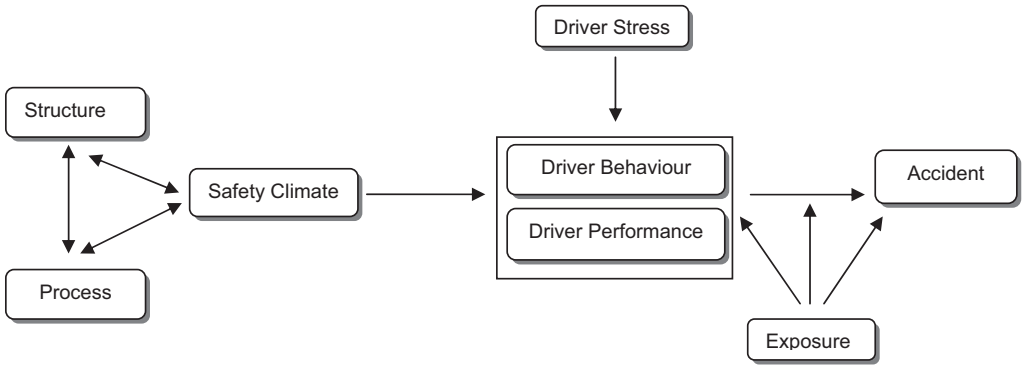

Figure 2.The tentative model describing relationships among safety climate, human factors, driver stress, and accident involvement concerning professional driving.

According to James and Jones (1974) organizational climate could be differentiated into two: structural properties of organization, like size and structure; and employees' perceptions about aspects of organizational environment. Similarly it was argued that culture should be investigated as interacting with other predominant characteristics of the organization. Guldenmund (2010) mentioned about an *organizational triangle where* three major forces operating within the organizations at the same time. The first one is the *structure of the organization*. Structure implies the formal organization covering for example the allocation of power within the organization, the mechanisms of coordination and control. That is, who is imposing the mission in what ways is emphasized. The second force is the *culture* of the organization including the basic assumptions and underlying convictions. This conviction is seen back in the structure and on the work floor. For example, conviction might influence how the supervisors are situated in the structure both organizationally and structurally. The last force is the *process*, which means actually primary processes exist in the entire organization. For example, a supervisor's aim might be to ensure commitment and reduce the violations. As a result of the interaction of these three forces behaviour is determined within the organization. The proposed model includes those aspects of organization as well to provide a complete picture of the concept of safety climate.

The model infers a relationship between safety climate and accidents through human factors, i.e., driver behaviours and performance. Driver stress was added into the model as the moderator variable, influencing this relationship by exerting an influence

on human factors. In other words, in this moderated mediation model (Baron & Kenny, 1986), or the model including conditional indirect affects (Preacher et al., 2007) the strength of the relationship between safety climate and accident involvement, through human factors, will be different for different types of driver stress. The relationship between safety climate and human factors (Sub-studies II, III and IV) and the one between safety climate and accident involvement (Sub-study III) has been evidenced in the present study. Also the present study showed that, although within group differences were observed for professional drivers in terms of stress reactions and risk driving (Sub-study I), these differences were not significant. However, there were significant differences in terms of the mentioned factors between non-professional and professional driver groups. Thus it might be argued that, some characteristics, (rather than the driver group/type) related to being a professional driver should be investigated while studying professional driving. This factor might be safety climate as it was proposed in Figure 2. Although the relationships between human factors and accident involvement have not been studied in the present study, a vast amount of studies in the previous literature indicated the existence of this relationship (e.g., Dobson et al., 1999; Özkan & Lajunen, 2005; Özkan et al., 2006a; 2006b; Parker et al., 1995a; 2000).

Driver stress, in the Sub-studies of the present study, was not investigated in relation to either safety climate or human factors directly. However, its relationship with speeding, which is a predominant violation having direct and causal relationship with accident involvement (e.g., Aarts & van Schangen, 2006; Carsten & Tate, 2005) was evidenced (Sub-study I). Additionally, the findings from the previous studies showing the existence of the relationship between stress and driving were used as a base to figure such a relationship for the proposed model. Westerman and Haigney (2000) conducted the first and the only study investigating the relationship between the DBQ and the DBI, which were indicated as two conceptually distinct measures. The researchers argued that driver stress is multi-faceted as driver behaviours, and it is possible that different facets of driver stress would have different influences on driver behaviours. Results of their study evidenced that high levels of stress is related to the increased self-reports of errors and violation. For instance, among the DBI factors, aggression/urgency accounted for the greatest amount of variance on the DBQ

factors. Situation specific tension and dislike of driving had also unique variances on each factor of the DBQ. Similarly, Simon and Corbett (1996) reported positive association of a measure of violation with self-report indices of general stress and driving aggression. According to Dorn and Matthews (1995) Driver Stress Inventory has showed that more severe stress reactions may disrupt driver performance and reduce safety.

As indicated by Westerman and Haigney (2000) the DBQ and the DBI are conceptually distinct measures. Although the names indicate a behaviour component for both of them, in the DBI, interactive effects of the driver's assessment of the task environment, his/her ability to cope with the conditions, and selection of a behavioural strategy has been emphasized to determine driver stress and driving performance, consequently. After the study of Matthews et al. (1997) the behavioural outcomes were kept out and the inventory has been renamed as the Driver Stress Inventory. In the present model, driver stress was defined according to the logic of the Driver Stress Inventory, and DBQ is the measurement tool used to get the driver behaviour information for more precise understanding of the nature of and the relationships between these two concepts within professional driving.

This model is a way to investigate the cross-level interactions in professional driving. However, it should be noticed that the model is tentative in nature and presented as a possible route explaining how factors from different levels influence each other. Testing such a model in the future studies might provide the literature with considerable insight on the relationships among organizational characteristics concerning safety, human factors in driving, driver stress and accident involvement. However, it is not possible to argue that it provides a complete understanding of the factors related to professional driving.

Implications of the present study

The present research might be a small step to understand professional driving and the role of safety climate in professional driving. However, as the proposed model shows, it has implications for the present situation and directions for the future studies. First of all, safety climate and driver stress were modelled in relation to human factors and accident involvement. Although human factors, stress and accidents were the variables taken considerable attention from researchers

previously, they have not been studied in the way the present study proposed, which might provide an organizational frame of reference for professional driving for the future studies. In addition, comparisons among non-professional and different professional groups were limited and in the need of more detailed investigation with the inclusion of different driver groups. The present study provided the literature with some critical information regarding non-professional and professional drivers, including some differences among them. This new input to the literature might provide a base for the future studies on the characteristics and driving performance of different driver groups.

Another critical implication of the study is the development of the Transportation Companies' Climate Scale (TCCS), which is the first organizational climate measure developed specifically for the professional drivers. The TCCS has a very clear factor structure including three factors, supporting the literature emphasizing the multidimensional nature of safety climate (e.g., Cabrera et al., 1997; Zohar, 1980). Although some previous researchers indicated that sorting the items into a factor structure that has been published previously might be a way to end up with a set of core factors; direct comparison among the factor labels found in the previous studies might be problematic because of both methodological inconsistencies (i.e., differences in content, style, statistical analysis, sample compositions), and, cultural and language differences across countries and industries (see Flin et al., 2000; Guldenmund, 2000). These circumstances make it difficult to find evidence for a common set of core features for the investigated concepts. Nevertheless, as Flin et al. (2000) pointed out, for the construct validity to be obtained different climate scales administered to the same workforce could be compared. As the TCCS is the first measure specifically developed to gather safety climate information from the professional drivers, it can provide a basis for such a comparison to be made in the future.

CRITICAL REMARKS

Before the concluding remarks, some critical issues related to the present study should be mentioned about. The first issue might be that, organizations are composed of both formal and informal parts. In the present study, by focusing on safety climate, the informal part was mentioned about, which cannot be separated

from the formal part in fact. Accordingly, studies covering both formal and informal parts, as presented in Figure 2, might provide an extended understanding of the role and nature of safety climate in organizational contexts. Additionally, the concept of safety climate has some difficulties in terms of way it is studied. Even in the most recent times, most studies on culture/climate are in general dealing with how it influences safety. However, the way cultures/climates are created and recreated did not take considerable attention of the researchers. In order to end up with a complete understanding of the concept these issues should be considered. Another issue to consider might be the co-existence of other types of culture/climate related characteristics that might be interacting with safety climate in its relationships with other factors (Zohar, 2008).

Nature of the data collected/analyzed is another point to emphasize regarding the critical concerns of the present study. In the present study both professional and non-professional drivers were investigated in traffic setting. For most of the time, for the professional drivers, the results were explained as if they constitute a single group. However, literature indicated that employees understanding of 'culture' might change depending on some characteristics of the organization like size (Schein, 1992) and type (e.g., distributed organizations) of the organizations, as well as the characteristics, and, formal and informal rules related to different driver groups. If all the subjects are treated as a single group, the influence of those factors cannot be differentiated. One method of avoiding this limitation is the use of multilevel modelling (Nezlek, 2008). As the nature of the data collected for the present study was multilevel (i.e., individual, group and organizational levels), it would be appropriate to take into account individual, group and organizational level measures to figure out whether they have different influences on driving and accidents. However, the analyses conducted for the present study with a software developed for multilevel analyses (HLM 6.8 – Raudenbush et al., 2004) did not reveal interpretable results as a result of sample size issues at 'level 2' (e.g., organizational level).

Additionally, use of questionnaires and cross-sectional design of the sub-studies might be included as other limitations. It has been reported that climate studies were mostly conducted via questionnaires; even some authors argued that the culture studies conducted by gathering data via questionnaires are called climate research

(see Guldenmund, 2010). However, the use of questionnaire data might result the employees reflect the way they should feel, think and act regarding safety, rather than the way they actually feel, think and act (Antonsen, 2009; Guldenmund, 2007). In addition to the way they respond the questionnaire, 'which questionnaire to use' is another important issue to discuss. As for the organizational climate scale, some other measures to collect data should be investigated in terms of its applicability to any driver group. For example, the DBQ was not developed for the professional drivers (Wahlberg et al., 2011); a questionnaire developed to collect driver behaviour data from specific groups might provide more accurate information and results for the future studies. Concerning the cross-sectional design, it should be mentioned that cross-sectional studies cannot mostly determine causality which might be a critical problem in evaluating the results of the studies.

CONCLUDING REMARKS

Defined as a high-risk occupation more than thirty years ago (see Baker et al., 1976) professional drivers have been the subject of many studies. However, safety related behaviours and outcomes among professional drivers have attracted very little attention among safety researchers (e.g., Salminen & Lähdeniemi, 2002). It has been indicated that the researches based on the frameworks depending on the previous studies would result in more extensive and precise results (Shinar, 2007). Additionally theories and models of driver behaviour have been indicated as essential to understand how change in one variable (vehicle, social environment) can influence behaviour (Gielen & Sleet, 2003). The sub-studies of the present study and the model proposed in it has mainly focused on safety climate as a predominant organization related factor which was thought to be critical for behaviour, performance and outcomes of professional driving. Considering this aspect of it, the present study provided a contribution to the literature regarding the needed detailed investigation of organizational climate as an alternative performance indicator (Guldenmund, 2010).

According to the results, the present study evidenced the existence of the relationships among safety climate, human factors in driving and accident involvement. It is critical that the mentioned relationship has been evidenced via the use of a safety climate scale specifically developed for professional drivers.

Additionally, it has been shown that professional drivers are different from the non-professional drivers in terms of risky driving and on-the-road stress reactions; in addition to some within group differences.

It is clear that the future studies need a comprehensive point of view to be able to figure out how to construct/modify (if possible) organizational culture for safer organizations. In the present study a tentative model has been presented to be a part of a comprehensive model by providing a route to the relationships among safety climate, different professional driver groups, predominant factors in professional driving and accident involvement. As Shinar (2007) argued, models are critical as they describe behaviours within a framework of constructs appearing reasonable. Additionally they are useful because they might be considered as a tool providing countermeasures for behaviours (e.g., violations) and outcomes (e.g., accidents). Proposing a framework for the relationships among the predominant factors related to professional driving, the tentative model proposed in the present study could provide the future studies with a base where different levels of the traffic system were taken into consideration.

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